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GEOGRAPHICAL REVIEW

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VOl XXIII JUNE 1961 NO. 2

# A SCIENTIFIC SYMPOSIUM, "THE SOVIET GEOGRAPHY : REVIEW AND AIMS" AND ITS CONTENT

By **Academician I. P. Guerassimov.**

At the end of last year, a book under the title "The Soviet Geography : review and aims" was published by the Geographical Publishing House. This book is a fundamental scientific work of a reference character compiled by a large number of scientists on a commission from the Soviet Geographical Society Its principle aim is the comprehensive characteristic of the present state of Soviet Geography, its principal theoretical achievements and problems.

Compilation, from time to time, of such fundamental reviews is in the interests of the geographical science ; this gives the possibility to appraise critically the work for the last period and to outline, with good reasons, ways for further development.

At present the Soviet Geography especially needs such a review, first of all, in connection with the grand tasks of the current (7-year) and long-term plans of the development of national economy. These plans envisage all possible devolopment of productive forces of all geographical regions and a wide practical use of all scientific achievements. Besides, this review is very timely because of the reorganization of geographical methods by means of the assimilation of latest geophysical

and geochemical achievements. Lastly, compilation and publication of such a review is of great importance for the development of international scientific connections for the active participation of Soviet geographers in the work of international scientific Congresses and Conferences, and for the further rise of the world authority of Soviet science.

These main aims determined the programme of the Symposium. The content of the Symposium is as follows :

1. *History and present state of Soviet Geography* treated separately for the general (synthetic) branches of Geography (physical geography of lands ; physical geography of seas and oceans ; economic geography ; regional geography ; cartography ; history of geographical knowledge) and for the special branches of Geography (climatology, glaciology, permafrost study, hydrology of continents, geomorphology, soil geography, geobotany, zoogeography of continents, geography of population and settlements).

2. *Complex scientific problems and trends* elaborated by the Soviet Geography ( paleogeography of glacial period on the territory of the U. S. S. R. ; paleogeography of postglacial period ; thermal and water regime of the earth surface ; present state of the theory of geographical zonality ; problem of world ocean zonality ; snow cover ; landscape study ; natural regionalization ; complex map drawing ; economic regionalization ; problem of industrial and agricultural geography ; economic-geographical study of the complex development of productive forces in separate economic regions ; medical geography ; toponimy), and also an analysis of the role of geographers in the remaking of nature in the territory of the U. S. S. R. (study of natural resources ; exploration and developing of of polar regions ; geographical study and remaking of Taiga ; remaking of steppes and deserts ; geographical researches on the improvement of landuse).

3. *Method of geographical researches* (expeditions ; air photography and photogrammetry ; stationary physico-geographical researches ; analysis and experiment ; reserves and national parks of the U. S. S. R. ; methods of economic-geographical researches).

4. *Geographical education and popularization of scientific geographical knowledge in the U.S.S.R.* (secondary and high school geographical education ; amateur study of separate districts and its importance for the Soviet Geography ; touring and mountaineering ; publishing of geographical literature), and also a brief review of the history and activity of *the Geographical Society of the U. S. S. R.*

In compiling the Symposium more than 40 authors had taken part—the Soviet specialists in many geographical branches (V. I. Avguievich, G. A. Ausiuk, P. M. Alampiev, B. P. Alissov, D. L. Armand, V. G. Bogorov, M. I. Budyko, J. J. Gakkel, S. J. Geller, I. P. Guerassimov, A. A. Grigoriev, V. M. Gohman, T. F. Davitaya. A. D. Dobrovolski, G. K. Efremov, G. M. Ignatiev, E. I. Ignatiev, J. A. Isakov, S. V. Kalesnik, S. P. Kachurin, V. S. Klupt, S. V. Kirikov, O. A. Konstantinov, V. A. Kotelnikov, E. M. Lavrenko, D. M. Lebedev, M. I. Lvovich, E. M. Murzaev, M. I, Neustadt, V. V. Pokrzyszewski, V. S. Preobrazhenski, A. N. Rakitnikov, C. D. Richter, A. M. Riabchikov, K. A. Salishchev, J. C. Saushkin, A. I. Soloviev, V. B. Sochava, S. P. Khromov, A. H. Formozov, A. A. Shoshin, and others).

The general editing of the Symposium was carried out by the Editorial Board organized by the Geographical Society of the U. S. S. R. (I. P. Guerassimov, Chairman ; G M Ignatiev, Executive Secretary ; S. V. Kalesnik, O. A. Konstantinov, E. M. Murzaev, K. A. Salishchev, members).

It is quite natural that co-ordination of activity of such a great number of authors and of results of their work was a very difficult task for the Editorial Board. This problem is not completely solved. In the Symposium there are some contradictory elements, sometimes very considerable, which are kept partly in the interests of the authors' independence. Many efforts were made to keep only the contradictions based on the difference of scientific opinions. The debatableness of some theoretical questions of modern Geography is quite natural ; collision of contradictory opinions is always an important factor of further scientific devolopment.

However, it is more important, that the Soviet Geography has some basic theoretical principles which are shared by the over-

whelming majority of scientists. In the Symposium the author of this report made an attempt to expound those general theses in an introductory article. The content of this article can be briefly summarized as follows :

1. The geographical science in the Soviet Union has a long and many-sided history. Some stages of this development proceeded in pre-revolutionary Russia. The Soviet Geography, which appeared after the great October Socialist Revolution, obtained a great and valuable heritage from the pre-revolutionary Russian Geography ; this heritage consists in the great number of Geographical facts, as well as in the whole system of fruitful progressive scientific traditions, trends and conceptions many of which became classic. The Soviet Geography augmented considerably this scientific heritage by many facts, developed and enriched the classic scientific trends and created a number of new theoretical conceptions devoloped on the basis of scientific Marxism-Leninism and in close connection with the practice of socialist construction.

2. In the devolopment of the present Soviet Geography the main regularities of the world evolution of science are combining and *interacting* in a complicated manner with the peculiarities in the devolopment of Soviet socialist science. Schematizing slightly this difficult problem, we can characterize the recent tendencies in the devolopment of Soviet Geography as follows :

a. The primordial general aim of Geography as one of the oldest sciences, had always been and continues to be the aim of a thorough study of nature, population and economy on the territory of this country and its parts, all countries and all the earth as a whole. Such a study has to characterize thoroughly and to explain the various features of difference or similarity of natural conditions and local peculiarities of economy aud population. The scientific results of geographical researches are widely used in practice (revealing of natural resources ; agricultural mastering of territory ; rational distribution of industry, settlements and communications ; development of productive forces of different regions and countries.)

b. It is necessary to repudiate categorically the statement that the present geography has accomplished, on the whole, its cognitive-descriptive functions ; that the earth as a whole—or at

any rate its principal inhabited part—is studied geographically well enough, and so geography must be considered only as a school discipline of general education which is necessary for purely cultural purposes rather than for scientific and practical ones. Such an opinion is deeply erroneous and archaic.

c. The modern geography is a science of the XXth century. This is no longer a former descriptive-cognitive science with its principal aim—to explore unknown lands and countries. This is now a science of experimental-transforming character, which has as its main object the lands and countries discovered long ago with the nature profoundly changed by Man, with dense population and devoloped economy. That is why the principal task of modern Geography in the whole world is the comprehensive scientific service in the grand work of Mankind for the most intensive and diverse use of natural resources already discovered and for the remaking of nature and economy of many regions and countries.

It is necessasy to emphasize that simultaneously with the rapid development of the present techniques these new tasks of geographical researches become more and more complicated, since an efficient use of new techniques needs an especially thorough and differenciated knowledge of all the peculiarities of a territory being used, or of characteristics of a natural phenomenon being transformed.

3. A modern geographer has to ensure the geographical study of a territory and its typical phenomena, exact and various enough to satisfy the needs of practice. He has also to give a valuable scientific explanation of geographical peculiarities of a given territory based on the latest scientific notions. To accomplish with credit this important task, it is necessary to have a considerably deeper and more various scientific knowledge than in former times. It is necessary to use many new special methods of field and chamber investigations. All this work, as a rule, cannot be fulfilled at present in the limits of one science and by the efforts of one specialist. At the present stage of the development of Geography, a complicated system of science arises in place of the former indivisible science, and the collective work of many specialists organized under a definite plan in place of the work of one scientist with encyclopaedic knowledge.

Therefore, it may be said that the main feature of the present state of Geography in the U. S. S. R., as well as in other countries, is the complicated process of formation and development of the whole system of scientific disciplines arising in place of the former geographical science.

4. At present the main outlines of the system of geographical science, as well as the principles of their subdivision and correlation are rather distinct.

It is universally recognized by Soviet geographers that the subject of all the system of geographical sciences is the natural environment, i. e., the whole complex of correlated natural phenomena, population and social production, as well as connections of the natural environment with the social production and man's activity.

That is why at present the system of geographical sciences has to be subdivided into two sections, or subsystems : *physical geography* and *economic geography* ( including *geography of population* ). This subdivision ensues from the essence of the objects studied by Geography : on one hand—natural phenomena, and on the other—social one ( population and social production ). This subdivision is based on methodological principles and connections of corresponding geographical disciplines ( from cycles of physical or economic geography ) with natural or social sciences. The physical geography on the whole studies natural phenomena in a geographical aspect and proceeds from the regularities and development of natural phenomena determined by natural sciences. The economic geography studies the social phenomena ( peculiarities and distribution of economy and population ), and so proceeds from the regularities of structure and development of the society and being studied by social or socio-economic sciences.

A further subdivision of physical and economic geography is based on the following principles :

a) The main theoretical aims of physical geography are the study of an intercoditioned complex of natural phenomena constituting the natural geographical environment (sphere or envelope) on the whole, as well as the study of its seperate components. The first of these tasks is *the subject of general section of physical geography*, or *knowledge of the earth* which studies the natural

geographical environment on the whole and on a world scale. The description and the revealing of causes of similarity or difference of the geographical environment of separate parts of the earth's surface ( i. e., the study of natural geographical regions or landscapes ) are the subject of *the regional section of physical geography, or landscape study.*

The direct subject of the general, as well as of the regional parts of physical geography ( i. e. of knowledge of the earth and landscape study ) are complicated *combinations*, or complexes, of natural phenomena ; that is why these geographical sciences are of a special, *synthetic* character summarizing various data of many other geographical sciences.

A study in a geographical aspect of separate *components* of the natural geographical environment is the subject of a number of special, or *analytic* physico-geographical disciplines ( for example, climatology, hydrology, geomorphology, pedology, botanical geography and zoogeography, etc. ) constituting on the whole *the third special*, or *analytic section of physical geography.*

It is necessary to emphasize that the geographical sciences constituting this section have extremely close connections with two other sections. Synthesizing scientific materials, they "feed" by the results of analytic disciplines which, in their turn, are based on general and regional geographical regularities.

b) The principal theoretical aim of economic geography is the ascertainment of regularities of the geographical distribution of population and social production. That is why, simultaneously with the general and regional trends of economic geography studying the structure and distribution of population all over the world, as well as the distribution of social production on the whole or in separate countries and regions, the process of the development and separation of some subdivisions of the *special*, or *branch section of economic geography* is beginning to reveal itself : geography of population, geography of industry, geography of agriculture, geography of transport. etc. have become independent scientific disciplines.

5. The process of formation and separation of the different trends in the present system of Soviet geographical sciences, reflects the general regularities of scientific development. At the same time, this process is a contradictory and uneven one.

Different degrees of development of one or another geographical discipline, their different consolidation, as well as the different, level of their theoretical and practical achievements, give, on the whole, a rather complicated picture with many phenomena being fortuitous and inconsistent. The steady progressive development of new elements replaces in the field of geographical sciences (and not only in that field) the old notions and positions. However, these do not surrender without a struggle, the provisional and particular results of this struggle being different. All this is reflected in the modern Soviet geographical literature. Consecutive study of this literature gives a great material for the study of the rapid development of all the systems of geographical sciences under the condition of Socialism.

The Symposium is meant for different readers. Besides specialists in Geography in the broad sense (i.e. scientific workers in geographical, economic and biological sciences, as well as professors and teachers of universities), it must be of interest for many workers of planning and designing organizations, for economists working in industry, agriculture and transport, and for other specialists dealing with the study of natural conditions, with the use and protection of natural resources or with the development of productive forces in the different regions of the country.

# GHANA AND THE VOLTA PROJECT

By **P. K. Sircar**

Although for a general development of her economy Ghana had pinned her faith on a successful completion of the Volta River Project, owing to various difficulties the Project could not be implemented as originally envisaged. Currently, however, through a series of determined negotiations, Ghana has been able to revive the Project, but in a modified form, and preliminary work is under way at the foundation site of the Volta Dam. This article seeks to examine the Volta Project in retrospect, record the current progress and assess the future prospect of the Project.

## VOLTA PROJECT AND GHANA'S ECONOMY

Ghana has, what Boyon so picturesquely describes 'une économie fragile', characterised by the monoculture of cocoa, subsistence agriculture, an absence of large-scale industry and by its dependence on foreign trade.[1] Cocoa and minerals constitute more than 85% of her exports by value in any year, as is seen in the following Table I.

### TABLE I

**Value of exports by main commodities by % of total value of domestic exports**

| | 1958 | 1957 |
|---|---|---|
| Cocoa beans | 55.9 | 60.0 |
| Gold | 10.8 | 10.2 |
| Manganese | 9.9 | 8.3 |
| Diamonds | 9.9 | 8,3 |
| Total | 86. 5 | 86.8 |

[ From Ghana. *Economic Survey*, 1958 ( Accra, Ministry of Finance, 1959 ), p. 15. Tab. 8. ]

1. J. Boyon. *Naissance d'un état Africain : Le Ghana* (Paris, Armand Collin, 1958). Pp 23 *et seq.*

When it is remembered that world prices of cocoa and minerals are susceptible to wide fluctuations over which Ghana has no control, it becomes easy to understand why a diversification of Ghana's economy is essential. It has been felt that the latter could best be accomplished by envisaging the development of the Volta River on a multipurpose basis so that a cheap source of hydro-electric power could stimulate diverse industrial developments, including especially the electrolytic reduction of the huge and rich bauxite deposits, lying to the west of the Volta. The attendant benefits of irrigation and navigation would also help in the same direction. The completion of such a project will also have a great symbolic significance and a remarkable influence in ushering in an industrial revolution in Ghana.

## PROJECT BACKGROUND

The idea of such a project goes back to 1924, when the then Government of the Gold Coast had considered the possibility of aluminium production based on the potentiality of the Volta River. But several years elapsed before a South African, Duncan Rose by name, started the actual investigations in 1938, which were, however, cut short owing to the exigencies of the Second World War. The investigations were revived in 1945 by the West African Aluminium Ltd., a private company, with Mr. Rose as chairman. Things moved further when in 1947 the Aluminium Ltd. acquired extensive bauxite concessious in the country and two years later gained interest in the West African Aluminium Ltd. Later on the Gold Coast Government collaborated in the technical investigations and the British Aluminium joined the Aluminium Ltd. on the commercial side.

The preliminary enquiries made one thing clear. It was the need for a substantial Government participation to make such a project a success. In a white paper in November, 1952 ( Cmd. 8072 ), the British Government published an outline of the scheme and of the results of the discussions held between them and the Goverment of Gold Coast and the two Aluminium Companies. The conclusion of the White Paper was that the Project was feasible and that joint participation would be recommended to the respective Governments. The cost was then estimated at £.144m distributed among different items and interests as follows :—

### TABLE II

**Estimated Cost of the Project in £ million**

| Items/share of | Gold Coast | U. K. | Aluminium Companies | Total |
|---|---|---|---|---|
| Port, rail, road & other public services | 26.0 | — | — | 26·0 |
| Power project (capacity 564,000 kW.) | 8.0 | 46.0 | — | 54.0 |
| Smelter | 10.7 | 10.7 | 42.6 | 64.0 |
| Total | 44.7 | 56.7 | 42.6 | 144.0 |

[ From White Paper on the Volta River Aluminium Scheme (London, 1952) ]

To go into the details of the scheme and to work out a time-table for it a Preparatory Commission was appointed in 1953, which published its Report in 1956.

## PREPARATORY COMMISSION

*The report of the Preparatory Commission of the Volta Project* (London, H. M. S. O., 1956) is a very costly publication and runs into three volumes. The whole scheme, as envisaged therein, comprises the following several projects (Fig. 1) :


FIG. 1 VOLTA RIVER SCHEME

1) Development and operation of new bauxite mines in the Aya/Yenahin area, about 35 miles west of Kumasi, where there are deposits in a range of hills rising to over 2,000 feet above sea level. It has been estimated that the total extent of the deposits would be of the order of 200 million tons of bauxite, but of which only 140 million tons had been proved.

2) Building of approximately 83 miles of railways to transport the bauxite and ingot etc. Three links would be required ; a) extension of the Kumasi line to Yenahin to get at the bauxite (39.8 miles) ; b) a short link to Kpong, the site of the proposed aluminium smelter, from the main Kumasi-Accra line (28.7 miles) ; and c) new lines joining the proposed Tema harbour on the coast to Kpong via the Shai Hills (14.6 miles).

3) Construction of a large dam and power station at Ajena for a firm output of 617,000 kW. of continuous power. The hydrograph (Fig. 2) shows monthly discharge of the Volta at dam site in 1952 and 1953.

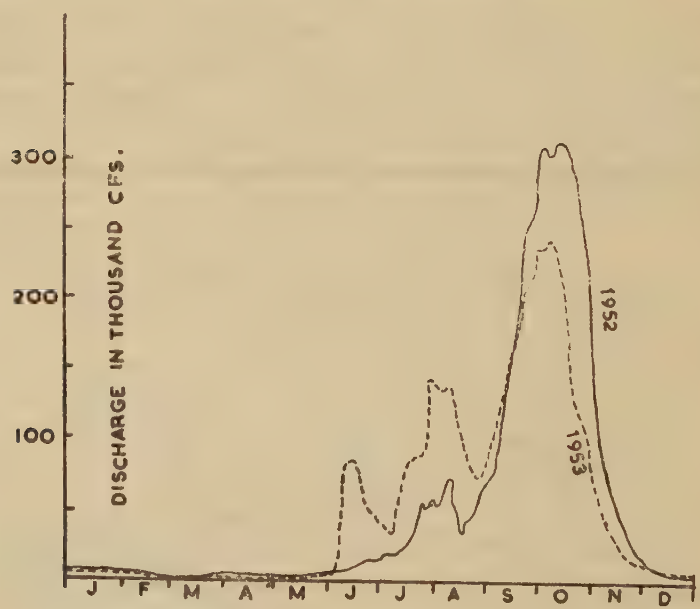


Fig. 2

4) Development and operation of an aluminium factory and a smelter at Kpong, with an ultimate capacity of about 210,000 tons of metallic aluminium.

5) Construction of new roads to provide access to the main works and to replace those which will be submerged by the creation of the Volta reservoir.

6) Development of a new port at Tema to handle the flow of imports and exports associated with the scheme and generally to provide additional port facilities in Ghana.

7) Development of new townships at the sites of bauxite mines, of the dam, of the smelter and at Tema.

The total estimated cost of £. 231.3 millions was distributed as follows :

## TABLE III

**Estimated cost of the Project by the Preparatory Commission in £ millions**

| | Initial stage | Intermediate stage | Final stage |
|---|---|---|---|
| Aluminium Production | 80,000 tons | 120,000 tons | 210,000 tons |
| Jointly financed | | | |
| A. Dam & Power installation | 60.2 | 64.0 | 67.6 |
| B. Smelter & mines | 43.1 | 57.9 | 91.2 |
| Gold Coast Govt. financed | | | |
| C. Railways | 15 9 | 16.6 | 18.1 |
| D. Other direct commitments | 2.5 | 2.8 | 5.0 |
| E. Other possible investments arising out of the Project | 1.5 | 4.2 | 10.0 |
| F. Allied development expenditure* | 39.4 | 39.4 | 39·4 |
| | 162.6 | 184.9 | 231.3 |

[From the *Report of the Preparatory Commission*, Vol. 1, P. 70]

*Covers investment in port, town and road development which the Gold Coast Government has already decided to undertake irrespective of decision on the Volta Project, but these are vital to the Project itself and hence included here.

Thus the estimated cost for the completion to the final stage of the scheme comes to about Rs. 307 crores (1 crore=$10^7$). This compares with Rs. 173.5 crores for the Bhakra and Rs. 73·8 crores for the Hirakud Projects in India.

## FINANCING THE PROJECT

"By the time the Report (of the Preparatory Commission) was published the project seemed as forlorn as a bride in church whose groom has failed to arrive."[2]

It was obvious from the beginning that it was beyond the capacity of Ghana to finance such a big project by herself alone. The gross fixed capital formation in Ghana is low, so also is her gross domestic product, as is evidenced in Table IV. It is a vicious circle, to break which an injection of capital from outside is very necessary.

### TABLE IV

**Domestic Product and Capital formation in £G million**

| | 1954 | 1955 | 1956 | 1957 | 1958 |
|---|---|---|---|---|---|
| Gross domestic product | 348.2 | 327.5 | 343.7 | 351.4 | 366.2 |
| Gross fixed capital formation | 38.9 | 42.5 | 45.3 | 43.3 | 40.7 |
| Gross fixed capital formation as % of gross domestic product | 11.2 | 12.9 | 13.2 | 12.3 | 11.1 |

[ Computed from Ghana. *Economic Survey 1958*, ( Accra, Ministry of Finance, 1959), pp. 78 & 82. ]

In any case from the beginning of the investigations the U. K. Government and the two Aluminium Companies were greatly interested in the projects and it was but expected that they would all participate and share in financing the Project, which would benefit them all, if it became a success. But, according to a report published in *West Africa* on as far back as the 5th October, 1957, "none of the three parties originally concerned with the Project is now prepared to put into the Project its share of capital".

What were the possible reasons for such a *volte face* ? In the first place, with passage of time there was a general increase

2. *West Africa* No. 2229, 20 Feb, 1960. P. 205.

in the cost of the Project, and this meant that a possible investment had become less profitable. Political uncertainties in 1956 were also a contributory factor in the hestitation of the parties to take a favourable decision. In addition, for the British Government, by 1956 the nadir of dollar shortage was passed and thus there was no urgency for sterling area aluminium. Moreover, Aluminium Companies had been meanwhile expanding their production capacity elsewhere and the capacity became in excess of current rate of consumption. The Canadian Companies, which were mostly interested in the Volta Project, had expanded their production by more than 20% between 1952 and 1956.

### TABLE V

**World and Canadian Companies' production of primary aluminium in thousand metric tons**

| | 1952 | 1956 |
|---|---|---|
| World | 1800 | 2900 |
| Canadian Companies | 453 | 558 |

It thus seemed that since the Volta negotiations had begun, developments elsewhere had made the Project relatively less important to the Aluminium Companies. Towards the end of 1957 several similar projects for producing aluminium with hydroelectric power were far advanced in West Africa. Thus, at E′dea in the Camerouns a dam had been built, a smelter constructed and aluminium was being produced from imported bauxite. The capacity at E′dea was being extended and search for local bauxite was quite hopeful. Similarly, a French Guinea Project with the same object was under negotiation. From the point of view of the Aluminium companies, the Volta Project was one of the so many possible aluminium schemes in the area, but to Ghana it was much more than that. It was very vital to her industrial advancement. The question of her national prestige was also involved.

## FURTHER NEGOTIATIONS

So Ghana decided to fix the middle of 1959 as the limit for reaching a decision about the Volta Project ; the consolidated Development Plan had been prepared on that basis. That plan was already being implemented and despite the financial limitations imposed on Ghana by the world price of cocoa, over £1

million a month was being spent on "constructive development scheme." [3]

The progress at the Tema harbour and township was very satisfactory. When we visited Tema in July 1959, about 6,000 feet of the main breakwater and about 4,500 feet of the lee breakwater and the south breakwater had been completed. The stones weighing more than 7 million tons to build up these breakwaters had been brought over a new railway piece by piece frcm the gneissic Shai hills, 23 miles away. Some of the sheds were also almost completed. The harbour, enclosing an area of 500 acres, and costing £ 18 million, is expected to start functioning by the end of 1960. The fishing village had been rehabilitated in its new area. One community for 12000 people to live in had been completed and occupied, out of the seven that will comprise the township.

In April, 1957, came an American Group, which hoped that it could mobilise sufficient capital to underwrite the scheme. But the dead-line of 3 months given by the Government of Ghana expired without any concrete proposals emanating from the American Group. The Government of Ghana then felt it was quite free to negotiate with other parties.

It was then decided to arrange for a meeting with the Aluminium Limited. The Prime Minister said in the House that Ghana's interest would remain always safeguarded and that there would be a debate before any papers were signed. It was further decided the the Finance Minister would visit Canada and would discuss a loan from the International Bank for Reconstruction and Development.

Things looked up with the visit of the Ghana Prime Minister to the United States in 1958, when he made a personal appeal to President Eisenhower about the fulfilment of the scheme. As a result the U. S. A. signed an agreement with Ghana whereby the former Government gave a guarantee of the participation of the U. S. capital in Ghana's development.

## KAISER REPORT

A further outcome was that the U. S. A. jointly with Ghana sponsored a resurvey of the Project. In October 1958 the Kaiser Industrial Corporation of America was engaged to carry out a

3. *West Africa* No. 2108, 7 Sep. 1957, p. 849.

reassessment survey to bring up to date the cost of the Volta River Project as given in the 1955 Report. Moreover the Kaiser Corporation was authorised to negotiate with other Aluminium Companies to form a consortium for the operation of the smelter.

The Kaiser Report made a very favourable recommendation on the feasibility of the Project, but pointed out that a new site, about a mile downstream of the original site, would be more advantageous. The Kaiser Report have recommended the eventual construction of 3 dams on the Volta in the following order :

**TABLE VI**

**Estimates by the Kaiser Report**

| Dam Site | Capacity ( kW. ) | Cost of the Dam ( £G. million ) | Cost of Transmission System ( £G. million ) |
|---|---|---|---|
| 1. Akosombo | 768,000 | 55·7 | 12.0 |
| 2. Kpong | 140,000 | 15.5 | |
| 3. Bui | 93,000 | 25.5 | |

The project involves the production of electricity for large-scale aluminium smelting and for general industrial activities. Local bauxite from vast deposits could be used to feed a 220,000-ton aluminium smelter, which the re-assessment report recommends should be located at Tema, where some basic facilities have already been completed. The cost of power to the aluminium industry is estimated at 0.222 d initially and at 0.173 d per kWh at full capacity. The Preparatory Commission figures were 0.548 d and 0.305 d respectively. Possibilities of development of fisheries and inland water transport and of irrigation of the Accra plains have also been kept in view. The first dam can be built in 5½ years' time and the Accra Kumasi-Takoradi power grid can supply at ¼ of the cost of diesel electricity.

## RECORD OF PROGRESS

Ghana decided to accept these recommendations and to go ahead with preliminary works at the dam site, with the Kaiser Corporation in charge of the works.[4] A report by the Ghana Information Service of September, 1959, says that the Kaiser Engineers and Constructors Incorporated, a division of Henry

4. Information kindly given by Mr. Victor E. Wood, Second Secretary (Information), Ghana High Commission, New Delhi, on 19 Feb. 1960.

J. Kaiser, have begun preliminary works at Akosombo. Kaisers are constructing 15 miles of first class road to connect Akosombo to Kpong and a road, recently completed, links Kpong with Tema.

What is the progress with respect to the projected smelter ? Dr. Kwame Nkrumah, the Prime Minister of Ghana, in a speech before the National Assembly declared :

"Members will be pleased to learn that several aluminium companies are now setting up a new company in Ghana, which will be known as the Volta Aluminium Company (VALCO). During the next six to eight months the Government of Ghana will be negotiating with this new company, and I earnestly hope that the outcome of these negotiations will be the establishment of an aluminium smelter at Tema.

"Certain preliminary works have been undertaken during the last year which are nearing completion. The Government has now asked Kaiser Engineers and Constructors Inc. to carry out additional work at the dam site which will require until about March, 1961, to complete.

"In addition, Kaisers have been asked to complete all the engineering design work of the dam and to prepare tender documents so that the Government could act as necessary by the 1st September, 1961."[5]

Towards the end of January a strong team from the International Bank Mission visited Ghana with the task, *inter alia*, of making an objective appraisal of the Project and of arranging for the participation of Government and other parties in it. It seems that the direct participation by the Bank would be of a limited nature. However, the recommendation of the Mission would certainly carry weight with the interests concerned.

## PROSPECT

The present position thus seems quite hopeful. Tema harbour is on the way to completion, some of the roads have been finished and the dam at Akosombo seems certain to be built. If the VALCO can come to a positive decision, much will have been accomplished of the Project. A sure foundation will thus have been laid of a more prosperous and industrialized Ghana.

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5. *Ghana Today* (London), 3, 29 (Jan.6), 1960.

# AGRICULTURE IN NAINITAL TARAI AND BHABAR

By **Y. D. Pande**

Tarai and Bhabar region of Naini Tal district, U. P., is situated between 28°43'N and 29°35'N latitudes and 79°53'E and 80°1'E longitudes. It covers an area of 2,288 square miles (i. e., 84% of the district of Naini Tal.) Prior to 1890, the Bhabar tract of the present Naini Tal district formed a part of the bigger district of Kumaon. Till 1890 the area now known as Tarai parganas and Kashipur was a separate unit, under the administration of the Superintendent of Tarai. In 1891, the district of Naini Tal as constituted now, was formed by amalgamating the Naini Tal or Bhabar (as it was often called) Tahsil of the old district of Kumaon and the Tarai (including Kashipur), with headquarters at Naini Tal. Prior to our independence, as many as seven attempts were made to settle this tract fully but all of them failed mainly due to three reasons : (a) unhealthy climate ; (b) insecurity of life and property in this densely forested tract and (c) half-hearted and patchy nature of efforts made by the then rulers. Moreover, development of this region involved huge expenditure which British rulers did not consider profitable.

## NATURAL SETTING

When compared with the hilly tract of Naini Tal district, Tarai and Bhabar may be considered as a whole level, though altitude above the sea level gradually increases as one marches towards north. In the south general altitude is in the neighbourhood of 700 ft. while at the foothills in the north it is in the neighbourhood of 1900 ft.

Lying immediately below the foothills, Bhabar extends from the Sharda in the east to river Phika in the west. Uncultivated areas are usually covered with thick forests and the whole tract is conspicuous by the absence of surface water. Bigger streams (eight of them) preserve their course with some diminution in their volume, but all minor ones that have their origin in the lower hills of Naini Tal district, on entering Bhabar belt, soon

lose themselves in the shingly deposits of the tract. In times of flood, however, they are no doubt visible, but this appearance lasts so long as the cause exists.

Between the Sharda and the Phika, there is no well defined line dividing Tarai from Bhabar. To the east in Tallades Bhabar, there is less of Bhabar, and the swamps that exist now are not so extensive, but are at the same time more formidable, often being covered with tangled masses of canebrake. The Dhyanirau Bhabar is also comparatively narrow and it is not until we come to Chhakkata Bhabar that we get a breadth of 8 to 12 miles that lasts until river Phika is reached. At the southern limit appearance of Tarai may be felt in a line of wells with water table at three to six feet from the surface especially in the rainy season and running parallel to and bordering Bhabar.

Herbert described the Tarai as "defined in its southern boundary by a rise or step which runs parallel to common boundary of mountain and plain land"*. On a closer examination, no well defined boundary beyond the chain of springs is to be found. In no case there is any steplike rise as described by Herbert. Hodgson also accepted the existence of a longitudinal trough running parallel to the Himalayas as a characteristic of Tarai, which he held to be a natural depression in the plains and thus accounted for its peculiarities. This theory again is based on an erroneous idea, the fact being that the drainage of the higher country to the north, which has been lost in Bhabar, reappear in the line of springs which collect into swamps of the Tarai.

Much of Tarai land has now been cleared but in the recent past it used to be swampy throughout. Typical Tarai patches are still characterised by the presence of reeds and grasses. It is intersected by sluggish streams, which carry off only a portion of superfluous water by moving in tortuous channels. Average width of Tarai in Naini Tal district is about ten miles.

Climate of this region is sub-tropical. Mean annual temperature varies between 18° to 24°C ; mean annual rainfall varies between 1000 to 1800 mm, of which about 7% falls as winter rains during January, February and March, while about 80% is received from summer monsoons from June to September. Frost

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* Report of the Mineralogical Survey of the Himalaya Mountain, 1891 Extra-ordinary Number, Vol- XI, p- 73.

is almost absent in Tarai and rare in Bhabar. From November to March, heavy dew occurs at night. The winter rainfall decreases from north to south as well as from west to east ; in June, July, August and September the rainfall decreases from east to west, while north-south trend remains the same (Table I).

## TABLE I

### Average Monthly Rainfall in millimetres.

| Station | Height in ft, | Jan. | Feb. | Mar | Apr | May | Jun | Jul. | Aug. | Sep. | Oct. | Nov. | Dec, | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Haldwani | 1430 | 41 | 49 | 21 | 12 | 36 | 241 | 622 | 612 | 276 | 36 | 3 | 21 | 1973 |
| Kilpuri | 800 | 30 | 35 | 16 | 9 | 28 | 167 | 39 | 417 | 233 | 37 | 6 | 11 | 1428 |
| Kashipur | 760 | 33 | 40 | 14 | 11 | 23 | 164 | 366 | 367 | 213 | 36 | 5 | 12 | 1284 |
| Rudrapur | 720 | 27 | 34 | 14 | 7 | 19 | 131 | 393 | 370 | 206 | 33 | 5 | 13 | 1252 |
| Bahari | 690 | 28 | 3[illegible] | 16 | 7 | 32 | 135 | 448 | 294 | 166 | 29 | 5 | 11 | 1208 |

From April till the break of the monsoon in June, the thermometer shoots up (often touching 45°C) in the day while nights are relatively cool. This heat and dazzling sunshine is very much detested by hilly people. After sunset, the cool "dadu"* which blow down the principal valleys exerts a modifying influence on the neighbouring Bhabar. In summers, during the day, modified form of 'loo' or Blandford's 'winds of elastic expansion' is to be observed. There is no snowfall in this region, though hail is not uncommon.

Soils of Tarai are youthful and immature. Youthfulness is exemplified by the presence, in high proportions of undecomposed plant residue, and coarse sand, the latter attaining as much as 26% in the fourth layer. Thus overlying layers of clay have been deposited over the coarser material. So far as horizontal distribution of soils is concerned, Tarai soils fall into three groups : (a) Lowlying riverain soils, (b) Soils found on gentle slopes and (c) Soils of the alluvial flats. Lowlying riverain soils are silty or sandy loam depending on the preponderance of either silt or fine sand, which together constitute 80% of the total. Calcium content in these soils is high. These soils are greyish in colour. Nitrogenous and other organic matter decreases with depth. Soils of the second group are found in northern parts of Naini Tal Tarai where water table is generally high. These

* "Dadu" is a word of Kumaoni dialect locally used for mountain breeze.

soils are clayey in nature ; silt and fine sand together constitute over 90%, but calcium content is insignificant. Colour of these soils is light grey. The soils of the third group are closely akin to wet riverain soils of the first group described above. They are clayey on the surface but loamy below, resting on sandy sub-soils Though clayey, calcium content is almost nil, but they have adequate organic matter although there is an abrupt vertical diminution of nitrogenous material.

In Bhabar three soil horizons are distinguished. The surface horizon is generally nine to eleven inches thick having in the whole poorer soils (excepting in low flood-plains), with a thin surface layer of silt, thickness of which varies from place to place depending on local factors. This horizon has a mixture of small pebbles. The second horizon is about three feet in thickness, and generally consists of pebbles which are somewhat larger than those found in the first horizon. Generally they are three inches in diameter. As one proceeds downwards size of the pebbles increases. Lowest horizon sometimes reaches a depth of fifty feet. The author observed third horizon by the side of river Gaula near Haldwani at depth of about 40 feet from the surface. Bhabar soils are notorious for their porosity, thereby creating irrigation problems in a belt where rainfall is by no means insufficient for agricultural pursuits but for the peculiar nature of the soils.

## AGRICULTURE

As is evident from table No. II, about 27% of land of Naini Tal Tarai and Bhabar cosists of agricultural area. 64% of the population of this region depends on this basal activity. Hilly tract of Naini Tal district is characterised by minute size of agricultural holdings, old and out of date implements, wasteful methods of cultivation, dearth of irrigation facilities, poor cattle wealth, mountainous nature of countryside, change of agricultural character with site elevation and aspect of the ridges. Cultivation in the hilly tract is so intensive, terraced fields so tiny, that it will be apt to give it the name of gardening. Batten has given a picturesque description of cultivated valleys of the hilly tract. He writes, "The mixture of natural scenery of wood

and water, the care displaying fertility of innumerable fields, and the sprinkled human habitations remarkable for their pretty architecture, make up a picture which it would be difficult to equal in any part of Asia."* But the picture in Tarai and Bhabar is quite different. As contrasted with the flight of steps and patchy character in the hilly tract, Tarai and Bhabar is an area of continuous fields ; excepting near older settlements, it is an area of relatively larger agricultural holdings and larger Tarai farms even with mechanised agriculture. Maximum size of holdings is to be found in two colonization areas the Tarai colonization scheme in the heart of Rudrapur and Gadarpur parganas and the other ones in northern Kashipur pargana. Tarai State Farm has an area of 16,400 acres at one stretch. All land which has recently been reclaimed for agriculture, by public or private enterprise, consists of fertile land and large holdings.

Table No. II gives below the primary division of land of Naini Tal Tarai and Bhabar :

**TABLE No. II.**

**Classification of land**
**( 1957-58 )**

| | | |
|---|---|---|
| 1. | Forests | 10,01,513 acres |
| 2. | Not available for cultivation | 49,819 ,, |
| 3. | Uncultivated land other than current fallow | 1,38,627 ,, |
| 4. | Current fallow | 7,837 ,, |
| 5. | Net cropped area | 3,27,982 ,, |
| | Total | 15,25,778 acres. |

Out of the net cropped area shown in table No. II, about 32.1% is irrigated. This irrigation percentage is more than the average for U. P. as a whole (29.3%) and compares well with the adjoining districts of the plains. Still, there is a greater need of irrigation facilities in Bhabar. Another significant feature of the region is small current fallow area.

Cultivated area in Naini Tal and Bhabar has, of late, been showing an increase (Table No. III), although at the cost of our forest wealth. Moreover, there have been minor increases due to boundary adjustments that have recently been made.

* Batten, J. H,—Final settlement Report of Kumaon, 1851, P, 256

## TABLE No. III.

**Increase in agricultural area**

| Year | Cultivable area in acres (excluding forest area directly under control of the Forest Deptt. U.P.) | Total Cultivated area in acres |
|---|---|---|
| 1950-51 | 5,60,155 | 1,93.015 |
| 1951-52 | 5,62,147 | 2,54,456 |
| 1254-55 | 5,69,931 | 3,27,047 |
| 1955-56 | 5,72,990 | 3,27,982 |
| 1956-57 | 5,74,624 | 3,32,501 |

Increases in 1956-57 were also due to the fact that 746 acres of 'D' class Forest Department land was taken over and reclaimed for agriculture. It was further due to the fact that a village named Fazilpur with an area of 945 acres was transferred from Rampur district to Naini Tal district.

Successful reclamation efforts of the Government have changed the pattern. Much of the land which was previously considered unsuitable is now under the plough as a result of clearance of forests, grasses and weeds and improvment in drainage as well as incresed irrigation facilities.

Whatever be the practice, agriculture in the region consists of (i) wet and dry crops, and (ii) the autum (Kharif) and spring (Rabi) harvests. Wet crops are not necessarily irrigated. The Tarai ground retains sufficient moisture to cultivate them without irrigation. In this region, Rabi is essentially the crop of doabs and uplands, while Kharif is of floodplains. Besides, there is a third group of 'Zaid' crops which includes various vegetable and fruits.

## MAJOR CROPS :

Figures given in the following table (No. IV) show relative importance of major crops grown in this region.

## TABLE No. IV

### Acreage and Production of some crops in Tarai and Bhabar (1957-58)

| Sl. no. | Item | Acreage | Production |
|---|---|---|---|
| 1. | Wheat | 1,25,121 acres | 30,273 Tons |
| 2. | Rice | 1,21,926 ,, | 30,191 ,, |
| 3. | Pulses | 20,914 ,, | 4,242 ,, |
| 4. | Oilseeds (edible) | 31,000 ,, | 830 ,, |
| 5. | Gram | 26,016 ,, | 1,64,770 ,, |
| 6. | Maize | 44,986 ,, | 16.614 ,, |
| 7. | Barley | 5,288 ,, | 1,467 ,, |
| 8. | Mandua | 627 ,, | 177 ,, |
| 9. | Sugar cane | 50,516 ,, | 2,73,816 ,, |
| 10. | Spices | 9,792 ,, | Not available |
| 11. | Jute | 5,177 ,, | 1.518 bales |
| 12. | Tobacco | 118 ,, | 26 Tons |
| 13. | Fruit and Vegetables | 2,793 ,, | Not Available |
| I4. | Fodder | 7,877 ,, | ,, ,, |
| 15. | Cotton | 1,260 ,, | 209 bales |

## A—FOOD CROPS

### (i) Wheat :

Wheat is the most important crop grown in this region. In 1957-58, it occupied an area of 1,25,121 acres and its total production was 30,273 tons.

Pool has aptly remarked that wheat is the most widely grown of all the major cereals of the world*. Moisture and temperature have great importance in wheat culture. If cool moist season of formative growth is long, the grass-like development is good and heads many. Early sunshine that shortens the damp period is, therefore, important. In Tarai and Bhabar, winter wheat is grown while in Bhotia region of Kumaon wheat sowing is generally completed by the first week of June when the rest of

* Pool, Raymond J.—Marching with the Grasses, 1948, P, 29,

India is busy with paddy. Paul de Havesy has well said : "Wheat and man can endure almost any climate."

In Tarai and Bhabar, climate is comparatively moist and more suitable (especially Tarai) for rice cultivation. When rains stop in September and when cool season suitable for wheat has set in hurried arrangements for wheat cultivation are made. The advantage of long breaks, so common in Punjab and west U. P. is not available in this tract because of its having (Table No. I) almost continuous rains. The sowing season is therefore slightly delayed in this region. "It has been found through repeated experiments, years after years, that in U. P., the latter half of October, particularly the last ten days, is the best period for wheat sowings. Delay in sowing beyond October delays maturity and reduces yields."*

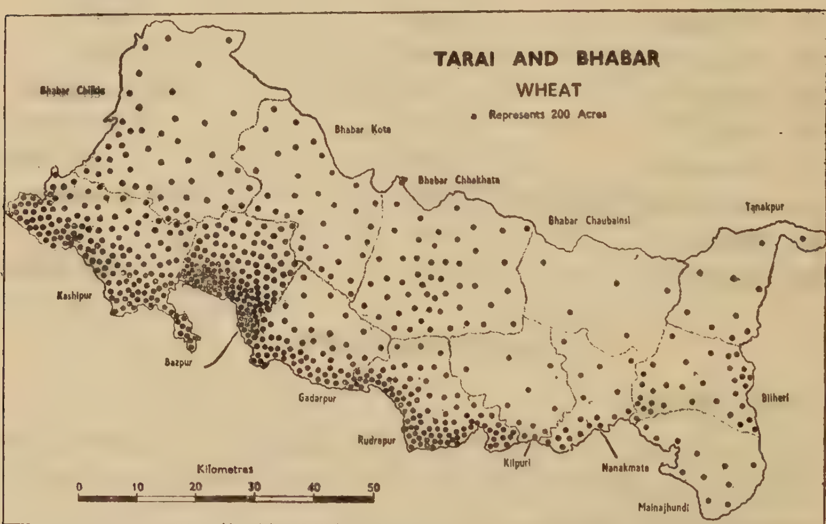


Fig 1

Wheat avoids heavy clayey soils. It is therefore not grown in low-lying water logged lands of Tarai. It thrives well in sandy loam. In the newly reclaimed lands where suitable soils (i, e., soils found on gentle slopes and soils of alluvial flats) exist, its result are most successful. In Bhabar (Fig. No. I) it is cultivated where adequate irrigation facilities exist.

Wheat is grown individually as well as a crop mixed with gram and barley. Cultivation practices are similar to those prevail-

* Mitra. A, K, and Mathur, V, S.-Wheat and its Culture in U.P, 1949,p,4,

ing in Ganga plains. Tractors are used in larger farms. Because of its being an exhausting crop, cultivators are concious of crop rotation. Common rotations are :

(1) Jowar—fallow—wheat.
(2) Early paddy—peas—Jowar or arhar—wheat.
(3) Green manure—wheat—fallow—sugar cane.
(3) Green manure—early paddy—wheat.
(5) Fodder (chari)—gram—green—manure—wheat.

Whea t dominates western part of Tarai and Bhabar while its acreage decreases with an increasing rainfall in the east. Higher acreage in Haldwani pargana (Bhabar) is due to greater irrigation facilities there. Following table (No. V) emphasises the dominance of western part (Fig. No. 1) :

**TABLE No. V.**

**Parganawise acreage of wheat.**

**(1958-59)**

| Sl. No. | Parganas | Acreage |
|---|---|---|
| 1. | Bhabar Chhakhata | 9,996 acres |
| 2. | Bhabar Chaubainsi | 1,064 " |
| 3. | Bhabar Kota | 7,116 " |
| 4. | Chilkia | 7,785 " |
| 5. | Bazpur | 27,814 " |
| 6. | Gadarpur | 11,986 " |
| 7. | Rudrapur | 19,920 " |
| 8. | Mainajhundi | 2,208 " |
| 9. | Kilpuri | 2,228 " |
| 10. | Nanakmata | 3,654 " |
| 11. | Kashipur | 31,440 " |
| 12. | Bilheri | 6.555 " |
| 13. | Tanakpur | 1,920 " |

There has been all round increase in wheat acreage recently. This is because of prevailing high prices of wheat, reclamation of new lands as well as Government's food compaign. An idea of this increase can be had from the following statistics of pargana Rudrapur :

## TABLE No. VI

**Showing increase in wheat acreage in Rudrapur**

| Sl. No. | Year | Wheat acreage |
|---|---|---|
| 1. | 1934-35 | 2,450 acres |
| 2. | 2939-40 | 2,467 " |
| 3. | 1944-45 | 3,276 " |
| 4. | 1949-50 | 3,666 " |
| 5, | 1153-54 | 17,075 " |
| 6. | 1958-59 | 19,920 " |

The average yield of wheat per acre is 7.6 maunds or 625 lbs. The yield does not compare favourable when compared with wheat producing important states ; it is even lower than the average for India. It therefore emphasises the need for intensive cultivation and greater facilities for irrigation.

### (II) Rice :

Rice is second to wheat in acreage. It occupies an area of 121, 926 acres and its production in 1957-58 was 30, 191 tons.

Among the environmental factors affecting rice cultivation water supply is the most important ; amount of water needed in a given area varies with such factors as rate of evaporation, relative humidity and soil conditions. A total of 45 to 65 inches of rainfall is generally required for it. In Naini Tal Tarai and Bhabar rainfall varies from 50″ to 82″. But it decreases from east to west (Tanakpur 82.40″, Khatima 60.81″, Rudrapur 43.91″, and Kashipur 43.81″). Thus rice in western part of the region requires irrigation facilities for good yield. Furthermore,it requires a mean temperature of about 70° F during growing season for about four months. Such temperatures occur in this region. Although rice is grown on a variety of soils, there should be an impervious subsoil layer to prevent loss of surface water. If such conditions are lacking it will then require greater amount of costly irrigation water. This is the reason why rice fields in Bhabar require greater amount of irrigation water. In Tarai, calcarious nature

of soil is an additional advantage. This is why rice acreage in Tarai is greater (Fig. No. 2) than Bhabar.

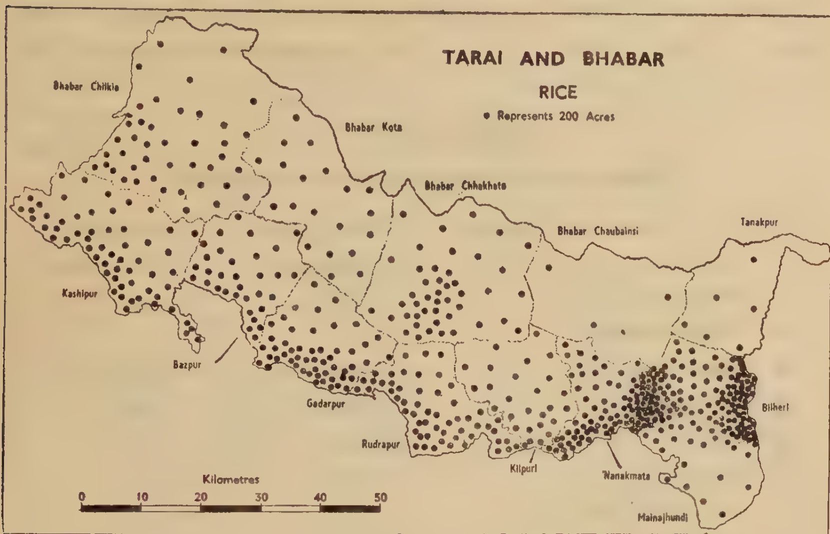


Fig 2

The technique of rice culture is akin to that existing in Ganga plains of U. P. On the basis of the technique of rice cultivation Roxburgh* suggested following classification :

(1) Early rice—"Usahan" as it is sown broadcast ; also called 'Bhadain' or 'Kunwari' as it is harvested in 'Bhadon' and 'Kunwar' months of Indian Lunar Calendar.

(2) Late rice—"Jarhan" as it is transplanted ; also called 'Aghani' because of its being harvested in 'Aghan' month of Indian Lunar Calender.

In this region early rice is mostly sown, its area in 1958-52 being 109, 540 acres as compared with 2,451 acres of late rice. (Figures of rice grown as Zaid crop have been excluded). It is sown in the best lands of the village and in Tarai can thrive on rain water only, but its yield suffers if sifficient moisture in the soil is not present. Wherever it is possible, irrigation water is provided to this variety. The late rice is however absent in Bhabar, the reason being that it requires clayey soils. In Bhabar, irrigation is necessary for both the varieties. The largest acreage

* Quoted by Dutta,—C. P. and Pugh, B M.—Crop Production in India, 1940, p, 182,

of late rice occurs in Rudrapur pargana. Late rice requires large but cheap manual labour for transplantation and weeding. Since it is not available due to sparse population, its acreage is not great. Following table (No. VII) gives parganawise acreage of rice :

### TABLE No. VII

**Parganawise acreage of rice in 1958-59.**

| Sl. No. | Name of Pargana | Early rice | Late rice |
|---|---|---|---|
| 1. | Kilpuri | 5,390 acres | 43 acres |
| 2. | Mainajhundi | 4,618 ,, | — |
| 3. | Nanakmata | 12,375 ,, | — |
| 4. | Rudrapur | 9,786 ,, | 1,562 acres |
| 5. | Bhabar Kota | 4,149 ,, | — |
| 6. | Bilheri | 28,114 ,, | — |
| 7. | Tanakpur | 1,262 ,, | — |
| 8. | Bhabar Chilkia | 6,664 ,, | — |
| 9. | Bazpur | 6,345 ,, | — |
| 10. | Gadarpur | 9,790 ,, | 559 acres |
| 11. | Bhabar Chhakhata | 8,833 ,, | 232 |
| 12. | Bhabar Chaubainsi | 503 ,, | — |
| 13. | Kashipur | 11,711 ,, | 51 acres |
| | Total | 1,09,540 acres | 3,451 acres |

Average yield per acre is 362 lbs. When these yield figures of the region are compared with that of rice producing countries and important rice producing states of India, we find that Naini Tal and Bhabar fares very bad.

**(iii) Barley :**

Barley is an important rabi crop occupying in 1957-58 an area of 5, 288 acres. Its total production was 1,467 tons. As contrasted to the hilly tract of Naini Tal district, it is more of a mixed crop in Tarai and Bhabar. Wheat has the distinction of being the breed crop of the world, rye......of being the most winter-hardy of the cereals, while barley is outstanding from the standpoint of being able to mature in a shorter season than any other cereal crop."* Barley can mature in a period of 90 to 100 days, with the result it can be grown in areas where the period

* Klages, K. W. H, - Ecological Crop Geography, 1946, P, 363.

of growth is cut short either by low temperature or by lack of moisture. It can also withstand a good deal of heat and a wide variety of soils. It is, however, reluctant to water logged areas.

As noted above, barley in this region is grown generally mixed with gram and wheat. Following table shows the acreage of barley grown as an exclusive crop in 1958-59 :

**TABLE No. VIII**

**Area under Barley in 1958-59.**

| Sl. No. | Parganas | Acreage |
|---|---|---|
| 1. | Bhabar Chhakhata | 1097 acres |
| 2. | Bhabar Chaubainsi | 45 ,, |
| 3. | Bhabar Kota | 355 ,, |
| 4. | Bhabar Chilkia | 372 ,, |
| 5. | Tanakpur | 23 ,, |
| 6. | Bazpur | 605 ,, |
| 7. | Gadarpur | 527 ,, |
| 8. | Rudrapur | 340 ,, |
| 9, | Mainajhundi | 100 ,, |
| 10. | Kilpuri | 277 ,, |
| 11. | Nanakmata | 342 ,, |
| 12. | Kashipur | 589 ,, |
| 13. | Bilheri | 182 ,, |
| | Total | 4,854 acres |

Table no. VIII indicates that barley is an important crop of Bhabar and western Tarai parganas.

**(iv) Other Food Crops :**

Other important food crops of the region are maize, gram jowar, bajra, mandua, and pulses like arhar, urd, moong, masoor etc. Mandua is a very important food crop of the hilly tract of the district, but in this region it is grown in Bhabar only. According to a local proverb of the hills, "Mandua is the king and wheat, the slave". Mandua is a poor man's fcod in the hills and is called 'Mandua Raja In the hillv tract of Naini Tal it is next only to wheat. In 1957-58, its acreage in the hilly tract was 18,282 acres and in Tarai and Bhabar 627 acres.

with a production of 177 tons in the region under study. In Bhabar mandua is grown in parganas Kota (579 acres), Bhabar Chilkia (22 acres), and Bhabar Chhakhata (26 acres), and is confined to more rugged northern parts near the foot-hills.

It is significant to note one contrast from the hilly tract. In the hilly tract black urd among pulses occupies largest area, while arhar is almost not grown, but in this region, black urd is not grown while largest area is under gram (39,776 acres), masoor 12,250, acres, urd 3,154 acres, arhar 609 Acres ; ).

## B-FOOD/CASH CROPS

**(i) Sugar Cane :**

It is the most important cash crop of this region. Its total area in 1957-58 was 50,016 acres and its production being 273816 tons. In this region it is widely grown as is evident from the following figures :

### TABLE No. IX.

**Area under Sugar Cane in 1957-58.**

| Sl. No. | Parganas | Acreage |
|---|---|---|
| 1. | Kilpuri | 620 acres |
| 2. | Mainajhundi | 587 ,, |
| 3. | Nanakmata | 213 ,, |
| 4. | Rudrapur | 14,344 ,, |
| 5. | Bhabar Kota | 675 ,, |
| 6. | Bilheri | 3,429 ,, |
| 7. | Tanakpur | 43 ,, |
| 8. | Bhabar Chilkia | 1,190 ,, |
| 9. | Bazpur | 7,525 ,, |
| 10. | Gadarpur | 867 ,, |
| 11. | Bhabar Chhakhata | 4,898 ,, |
| 12. | Bhabar Chaubainsi | 115 ,, |
| 13. | Kashipur | 15,350 ,, |
| | Total | 50,016 acres |

Sugar cane cultivation has recently been increased considerably in this region and is subject to mechanised ploughing in larger farms. Following figures for Rudrapur pargana give an idea of the recent trends towards increase in this region :

## TABLE No. X.

**Showing increase in Sugar Cane acreage.**

| | |
|---|---|
| 1934-35 | 1397 acres |
| 1939-40 | 2154 ,, |
| 1944-45 | 2736 ,, |
| 1949-50 | 3451 ,, |
| 1953-54 | 7313 ,, |
| 1957-58 | 14344 ,, |

Sugar cane is a tropical plant, hence its temperature and moisture requirements are naturally high. It shuns frost. During the growing season it repuires a temperature varying between 68°F to 88°F. Annual rainfall varying between 50″ to 70″ in this region is quite conducive to its growth and a large portion of its acreage in Tarai is without irrigation. Sugar cane grows

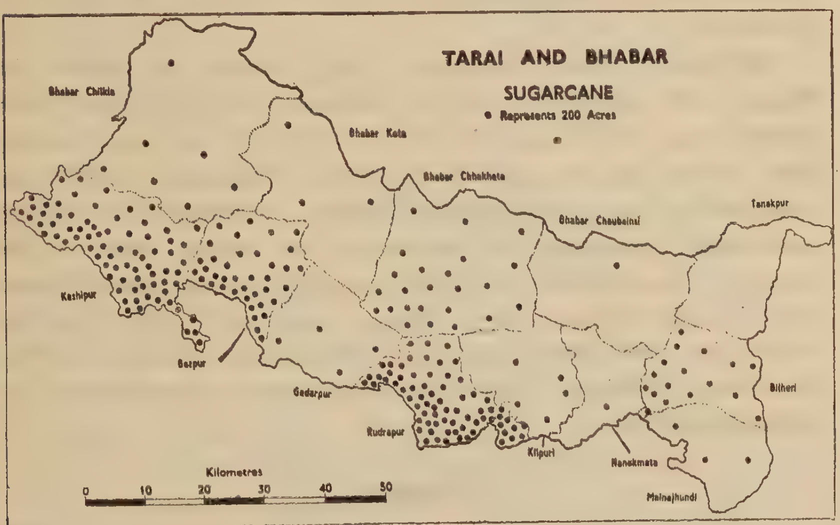


Fig 3

best in heavy soils, and is cultivated on lighter soils where there is plenty of moisture and organic matter. In Bhabar largest acreage of sugar cane is found in Pargana Chhakhata (Fig. No.3) where there are good irrigation facilities. Sugar cane cultivation requires large manual labour. In Tarai and Kashipur Colonisation scheme areas, some of the difficulty has been made over by mechanised ploughing. The average yield in colonisation tracts is 30.8 tons per acre. A large portion of cane is purchased by mill owners directly from the fields.

**(ii) Oilseeds :**

Total area under oilseeds (edible and non-edible) in 1958-59 was 34,387 acres, out of which 990 acres was under non-edible oilseeds. Amongst edible oilseeds, rape is the most important. Its acreage was 32, 728. and is widely grown. Oil seeds form an important cash crop of the region. After taking out seeds for sowing and home consumption it is sold out. a large portion of which is passed on to the oil mill owners of Haldwani, Ramnagar, Kashipur, Rudrapur, Kichha and Tanakpur.

**(iii) Fruits. Vegetables, spices, etc.**

The region produces a good variety of fruits, vegetables and spices. The important ones are mangoes, guavas, lichis. oranges potatoes, onions, peas, cabbages, turnips, cauliflowers, tomatoes chillies etc.

Kaladhungi, Kota, Ramnagar, and Haldwani are famous in Kumaon for mangoes, guavas, bananas, lichis. Largest area under mango (112 acres) in Pargana Chilkia, while that under lichi occurs in the neighbourhood of Kaladhungi. Lichi is exported in large quantities from Haldwani and Ramnagar. Total area under potatoes is 587 acres which are widely grown in the region. Parganas Bilheri, Chilkia and Kota are the most important in this respect. It is grown as a rabi crop. For the cultivation of onions, Parganas Chhakhata, Kota, Chilkia. Gadarpur, Kashipur, Bazpur and Rudrapur are important. Its acreage was 88.

## C-FIBRES

**(i) Jute :**

After partition, Government laid great emphasis on tts cultivation in this region. Encouragement coupled with prevailing high prices led to a phenomenal increase in acreage in a short time, with the result, it covered an area of 4,930 acres with a production of 1518 bales in 1957-68.

Jute requires high temperature and rainfall. The rainfall should not be only high but should be well distributed during the period of growth, with light showers and ample intervening sunshine periods. It is an exhausting crop, hence requires high

fertility of soils and ample but efficient manuring. In this region loamy soils produce quality jute whereas heaviest yield comes from clayey soil regions. In floodplain areas it is often grown without manuring. It requires large but cheap labour. According to the Director of Agriculture, Bengal, jute requires 82 man days and 29 bullock days in an acre of jute area in an average season.* Both upland and lowland jute varieties are grown in this region, but the latter variety is preferred as the former one

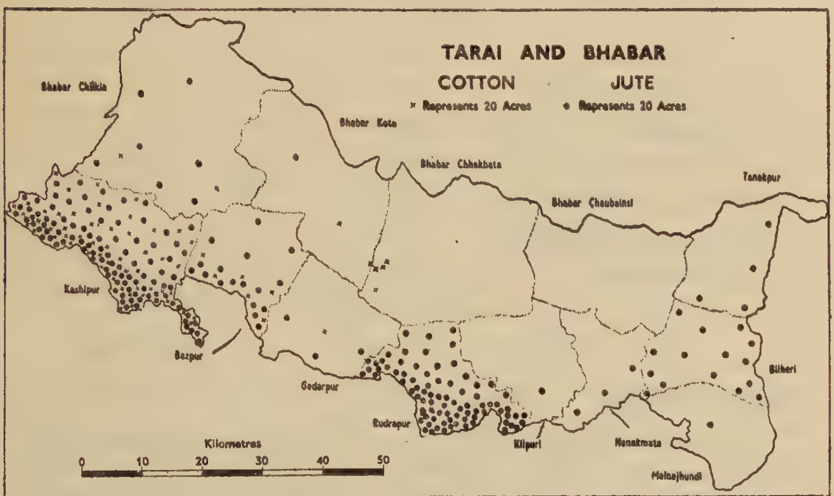


Fig 4

requires greater strain on farmer and irrigation facilities. Table no. XI shows parganawise acreage under jute. Its concentration in certain areas has been governed by availability of irrigation facilities and existing soil moisture. Average yield of 880 lbs. per acre in this region cannot be satisfactory, when compared with that of Bengal where it varies between 1200 to 1400 lbs per acre. Moreover, the quality here is not good and varies from place to place. It has been found that locality, methods of preparation of fibre, growth, environmental and seasonal conditions, rather than seed determined the quality". *

*Huque, M. A.—Man Behind the Plough, 1939, p. 51

* Dr, Burns, W,—Technical Possibilities of Agricultural Development in India, 1944, p, 93,

## TABLE No. XI.

### Area under Jute and Cotton in 1957-58.

| Sl. No. | Parganas | Jute acreage | Cotton acreage |
|---|---|---|---|
| 1. | Kilpuri | 13 acres | — |
| 2. | Mainajhundi | 15 " | 3 acres |
| 3. | Nanakmata | 66 " | — |
| 4. | Rudrapur | 1965 " | 4 " |
| 5. | Bhabar Kota | 30 " | 18 " |
| 6 | Bilheri | 291 " | 1 " |
| 7. | Tanakpur | 76 " | — |
| 8. | Bhabar Chilkia | 122 " | 43 " |
| 9. | Bazpur | 343 " | 111 " |
| 10. | Gadarpur | 67 " | 15 " |
| 11. | Bhabar Chhakhata | — | 5 " |
| 12. | Bhabar Chaubainsi | — | — |
| 13. | Kashipur | 1942 " | 1060 " |
| | Total | 4930 acres | 1260 acres |

**(ii) Cotton :**

It is a crop which prefers a warm, humid and equable climate particularly in early stages but it does not require heavy moisture. As is evident from table no. XI (Fig. no. 4), its greater acreage lies in western parganas of the region. Here it flourishes best in loams soils. Most of the cotton grown here is of 'desi' type, which is cultivated mixed with arhar. The area under American type in 1957-58 was 101 acres of which 82 acres of Pargana Kashipur only. Its total production in 1957-58 was 209 bales.

## SOME AGRICULTURAL PROBLEMS

As soon as one descends the hills, cultural landscape in Naini Tal Tarai and Bhabar completely changes. The flight of terraces, intensive handwork done by man in the fields of the hilly tract is not to be seen. The same monotony of the plains is to be seen. The use of animal in agricultural persuits increases. The side of fields, when compared with those in the hills, appear to be considerable. In colonization area one finds really large fields from the Indian standard. The Tarai State

Farm with 16,400 acres is claimed by the Agriculture Department to be the largest in Asia. The methods and techniques are the same as we find in Ganga plains, with the difference that in larger farms in Colonisation Areas, tractors are to be seen ploughing the fields. Recently, U. P. Government experimented ploughing in this tract with the help of elephants to economise purchase of tractors. According to a proverb it is easy to purchase an elephant but very difficult to maintain or feed him. So it is likely to remain simple Government's nightmare.

**(i) Irrigation :**

There are numerous streams traversing this region. In Bhabar the porosity of surface detritus has created peculiar irrigation problems. In Tarai, the soils in many places are waterlogged thereby making such localities ideal breeding grounds for mosquitoes. Additional moisture received through seepage from irrigation channels is likely to make Tarai soils alkaline.

After Independence, Government has undertaken to provide additional irrigation facilities. Significant feature of Government schemes lies in the construction of additional canals. Nanakmata dam is nearing completion. Older earthen dams have been replaced, channels improved and their mileage has been increased. It is expected that by the end of Second Five Year Plan 6,000 acres of additional land will be irrigated, resulting in an additional production of 1500 tons of foodgrains. As a result of Government irrigation schemes, about 5,000 acres of additional land was irrigated after the completion of the First Plan. Thus commendable work in this direction is being done by the Government. But a note of warning becomes necessary. Canal irrigation in Tarai is not very desirable, because seepage from canals is likely to do more harm than good in the long run. It is, therefore, suggested that greater attention should be paid towards construction of wells and tubewells in Tarai. Since water level in Tarai is high, construction costs will rather be insignificant but seepage will be considerably reduced. In Bhabar planned efforts are necessary. Till now, greatest beneficiary has been Pargana Chhakhata. Western parganas must get adequate representation immediately.

**(ii) Crop Rotation :**

Value of crop rotation in retarding soil exhaustion is well known. Rotation in this region is quite different from the hilly tract of the district. Rabi is far more important than kharif in Bhabar. Instead of usual three crops in two years of hills, five crops in two years is the general rule. In order to produce rabi crops of mustard and wheat, a very long rotation is practised. Rice and wheat are rotated as in the hills, but in the following year maize is substituted for rice. Maize is ready in about two months when mustard is sown. Mustard in its turn is reaped in December, and the fields are again sown with **Ganara (Panicum miliaceurn)**, which ripens in April. This type of close rotation usually impoverishes soil, and all crops in the series are not equally successful. In some places, for example in some villages of eastern Bhabar, rice is entirely eliminated, and tobacco and cotton are substituted for it. These are both commercial crops and yield better profit than rice. Fields adjoining cattle sheds are often heavily manured. Tobacco in such fields yeilds a heavy crop, hence is rotated with maize. Then wheat and cotton are raised. In the new lands of Tarai, simple rotation akin to Ganga plains of U. P. is followed. In the older tracts, rotation is a bit complex and has already been pointed out above (discussion on wheat). It will thus be seen that value of crop rotation is realised, but cash returns play major role than the retardation of soil exhausion.

**3. The problem of Fertilisers :**

If we follow the authority of Sir John Russel* and add 25% to the yields of this region, they still remain very low : rice 452 lbs. Per acre ( as compared with Japan's 2500 lbs per acre ) ; wheat 781 lbs. per acre ( as compared with 2285 lbs. per acre in Italy ). Main cause, as attributed by Russel, lies in the failure to use the fertilisers. Misuse of dung in India has rather been over emphasised. In this region where there are adequate forests, dung is rather utilised well ( excepting Kashipur Pargana southern parts ). The problem here is that the number of dung producing animals is not as large as it should be.

Mechanised as well as deep ploughing entails extensive use of manures, preferably fertilisers. In large farms insufficient use of

* Russel, Sir John, Report on Crop Production in India, 1937,

fertilisers is made. Green manuring should be encouraged since cattle manure in large quantities is not available. In Bhabar greater use of fertilisers should be made since deep ploughing is not advisable there.

"The conclusion seems inescapable that artificials must be supplied, and lavishly, even at financial loss to Government ; a loss which might in time be recouped financially by increased taxable capacity, which would certainly be worthwhile in terms of welfare. The steps taken in this direction seem, for once, all too timid".*

Emphasis on cereal cultivation in this region is not so as was originally thought. Cash crops occupied more than 20% of the cultivated area, and their acreage is gradually increasing. Opening of sugar mill at Bazpur had its results ; when sugarmill at Kichha starts functioning in 1961, the area under sugar cane is bound to increase further at the cost of food crops. Hence crop cultivation here must be planned in such a way that food requirements of marginal hilly tract ( Kumaon ) are at least fully met. The need of the day is to have a proper balance in food, cash and fodder crops.

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* Spate, O. H, K.—India and Pakistan, 1954, P. 239.

# OCCUPANCE IN RELATION TO GEOMORPHOLOGY IN THE VALE OF KASHMIR

By **S. C. Bose**

The oval shaped vale of Kashmir lies between the main Himalayan range and the Pir Panjal range in the State of Jammu & Kashmir ccvering some 4500 sq kilometres, the longer axis trending NW-SE parallel to the two ranges mentioned. *

## The Karewas

The valley has a nearly flat base at an altitude of slightly more than 1600 meters. During the Lower Pleistocene it consisted of a large lake, which is referred to as Karewa Lake, for the sediments laid down in its bed today form a significant geomorphological feature of the landscape of the valley, forming flat topped plateaus all round the valley and called Karewas by Kashmiris.

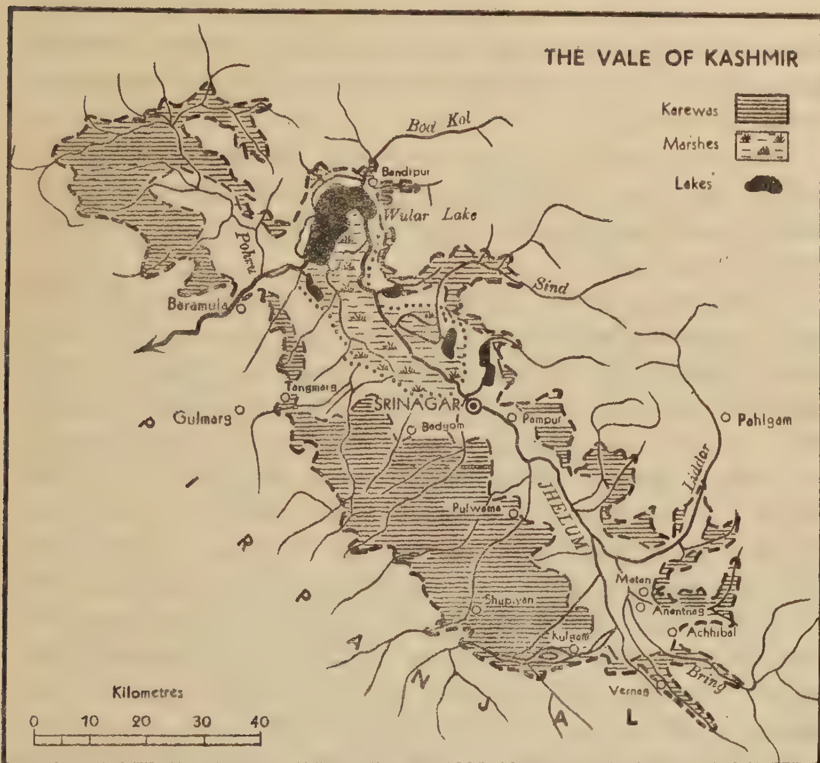
To understand the present location and structure of the Karewas it is necessary to have a broad idea of the tectonic and climatic changes which occurred in Kashmir during the Pleistocene.

A. L. Coulson[1] has admirably summarized the work of various geologists on this subject up to 1937 in a paper on Pleistocene Glaciation in North-Western India. He has stated and criticised the views of H. B. Medlicott, C.S. Middlemiss, R. D. Oldham, H. de Terra, B. Sahni, D. N. Wadia and others.

According to de Terra and Teilhard de Chardin[2] there were four distinct glacial phases interrupted by three longer interglacial phases during the Pleistocene. Also in this interval there were two or more uplifts of Pir Panjal range. At the beginning of Pleistocene a slight rise in the range that was the precursor of the Pir Panjal, an obstruction was caused near Baramula resulting in the creation of Karewa lake. Subsequently, in general, the lake bed became deeper, while the flanking ranges rose higher, and from them fluvial, fluvio-glacial and morainic materials were deposited in the lake bed for nearly the whole of Lower and Middle Pleistocene The nature of this deposit varied according to the change in

* Photographs appearing in this paper were taken by the author during his visits to the valley in May 1928, September 1949 and August 1960

climate and the rise of Pir Panjal. The lake level also fluctuated accordingly and was further controlled by the erosion at the outlet near Baramula.




Map shows the extent of the Vale of Kashmir bounded by the thick broken line. The area outside it consists of high mountains.

Karewa beds have a total thickness exceeding 2,200 metres,[3] but it is difficult to estimate the exact thickness, due to folding and unequal erosion. The lowermost Karewas were perhaps laid near the end of Pliocene, when the first glacial phase set in and a slight upheaval of Pir Panjal created the lake. Throughout the first interglacial period during Lower Pleistocene the Lower Karewa beds were deposited. They are fluvio-glacial in nature in general. The lake drained off after this for a small period when the Lower Karewas were denuded about 700 metres from the tops of two flat anticlines.[3] The lake formed and deepened again as the second glacial phase set in, and the Upper Karewas were laid over the Lower Karewas, with an unconformity inbetween

This deposition continued during the sccond interglacial phase in Middle Pleistocene. In Upper Pleistocene a third glacial phase set in, while the lake was gradually drained off. In the last stages forests appeared over portions of the valley, which are today preserved as interstratified beds of thin but extensive seams of lignite which are in workable proportion in some localities in Hundawar tehsil.

The final draining of the lake was perhaps caused by the cutting back by river Jhelum through the obstruction near Baramula and capturing the upper vallay, which at that time was part of Chenab basin.

In the post-Karewa period the Pir Panjal rose nearly 2000 metres, while the lake had disappeared. The Karewa beds were partly involved in this orogenesis. They were slightly folded and tilted in some places, specially near the base of the Pir Panjal where at some places they dip 40.° The dip is generally towards the valley. Portions of the Karewas were lifted even up to 4000 metres.[3] A small portion of Karewas was located by Coulson at Linyan at an altitude of 3100 metres near Gulmarg Fluctuating ice ages produced boulder beds and moraines which lie embedded in the Karewas. The fourth glacial age spread tongues of glacial moraines over them. The meadow of Gulmarg is situated over one such moraine lying over the Karewas. Another morain lies exposed at Khilanmarg above Gulmarg (Fig 1)

Subsequent erosion is now gradually removing the Karewas from the valley. But nearly half of the valley is still covered by them. The present Wular and other lakes such as Manasbal and Dal, and many other marshy areas such as Anchar are not the remnants of the past Karewa lake,[6] for the top beds of Karewas which were at the bottom of the Karewa lake now lie much above the lower valley. The present lakes are, in all probability, caused by a slight, very recent, rise of the Pir Panjal, causing a rise in the obstruction near Baramula. In all probability the present lakes were all joined together and consisted of a single sheet of water not long ago.[7] A slight lowering of the outlet at Baramula has caused them to disintegrate.

The erosion features at the edges of Karewa platforms also suggest a slight rise in the recent times as the streams flowing through them cut deep gorges near the eroded edges which stand

abruptly as scarps, while an the top of the Karewa they, flow gently over slightly undulating country. The gorges of Ningal Nala[1] and Ferozpur Nala on the two sides of Gulmarg are good examples to illustrate this point. The scarp-like face of the Karewa facing the road between Bhawan ( Matan ) and Pahlgam and gorges opening out on its sides are further proof of this phenomena.

. The best view of Karewa topography is obtained from spurs of adjoining hills. The Karewa of Martand above Bhawan (Matan) can be viewed from a small temple on a spur to the west. A general view of the valley from the northern face of Banihal pass ( fig 2 ) is also instructive. The spread of Karewa flat tops at the base of Pir Panjal is seen most clearly from the air as the plane rises from Srinagar landing ground to cross Pir Panjal.

In places small portions of Karewa beds have been isolated and lie as mounds, such as those near Pampur.

The broadest spread of Karewas borders the Pir Panjal, but narrow belts occur along the northern edge also. They provide alignments for roads, which avoid the valley bottom liable to flood. The road from Shadipur, skirting Manasbal lake and proceeding towards Bandipur passes over such a narrow belt At places the Karewa beds penetrate valley bottoms between spurs and form little flat valleys urrounded by hills, such as the Lolab valley east of Wular lake. An arm of the past Karewa lake penetrated the hills here.

The bigger rivers like Liddar, Bring, Sind, Bod Kol and Pohru have cut deep in the Karewas and have washed away all the Karewa material very often right up to the edge of the mountains, and separated the Karewa flats into blocks

Usually the Karewa tops have a dry aspect, and are covered by scrub jungle, but Kashmiris have evolved a method of irrigation suited to the topography. Small rivulets descending down from the adjoining mountains are artificially distributed to a number of channels expanding out like a delta and irrigating the land. The channels are called 'Kuls'. With great igenuity they are taken to various levels to irrigate terraced fields.[6] Wheat is grown in the same manner as spring wheat in Canada. It is sown in the late autumn and lies dormant covered by snow. In spring it sprouts

as the snow melts. Rice grows in the rainy season by the help of irrigation from Kuls.

Throughout the northern slopes of Pir Panjal where the Karewas extend in a broad belt the irrigated portions consist of green fields of wheat, rice, maize and barley. Maize usually grows on higher lands which cannot be levelled as much as paddy fields need, and where water supply is insufficient. But in favourable conditions paddy fields appear even at an altitude of 2,500 metres. But perhaps the conditions for maize are ideal in the cool damp climate. Barley grows higher up. Badgom, Shupiyan and Kulgam are large prosperous villages along this belt.

The dry apect of the Karewa tops also encourages tree culture. Almonds specially flourish in bouldery soils in higher portions. In damp situations lower down, willows are grown to supply twigs for wicker work. Peaches, plums, apricots and apple gardens are located on sloping grounds where grain cultivation is not possible. Dry grass and fire-wood is collected from adjoining hill slopes. (Fig 3)

The Karewa of Ferozpur near Tangmarg presents a pleasant aspect of green fields, gardens and rows of willows, poplars and other trees. Here the irrigation channels are taken out from Ferozpur Nala descending from the snow covered ranges above Gulmarg. They are broken into a number of levels and supply copious irrigation water to the fields and gardens. (Fig 4)

As compared to the Ferozpur Karewa, the Karewa of Martand above Bhawan ( Matan ) appears as a vast open field presenting a scarp face towads the Liddar river flowing below it. But the water of Liddar is caught higer up near Pahlgam and brought by a canal to its surface. The canal here breaks into a number of branches and irrigates the Karewa. Past prosperity of this Karewa is reflected in the occurance of ruins of the massive temple of the Sun built by king Lalitaditya in the 8th century.

Mention may also be made of detached mounds of Karewas near Pampur which are famous for their saffron fields[4]. The flat top here has been further eroded to undulating mounds. The saffron fields are vey carefully prepared. The plant, an autumnal Crocus, grows out of a bulb which is planted in specially prepared beds in rows, which are properly spaced. Every year the bulbs sprout in early autumn and are in full bloom on the full moon of

Fig 1. Moraine deposits on the slopes above Khilanmarg. Note the boulders strewn all over the area and the level valley bottom in the distance. Dense Deodar forests cover the hills around Gulmarg lying between the valley bottom and Khilanmarg.

Fig 2. A view of the valley from Upper Munda below Banihal Tunnel. Karewas are seen in the foreground. Terraced paddy fields, poplars and willows are seen in the middle.

Fig 3. Kashmiri grass collectors near Harwan. A number of men and women are engaged in collecting grass and firewood from the surrounding mountain slopes.

Fig 4. The Karewa of Tangmarg. An ingeneous type of irrigation from Ferozepur Nala has converted it to a rich garden land and green paddy fields. The picture, taken in autumn, shows harvested paddy lying in the fields. The forests of Gulmarg are in the background.

Fig 5. A full omega-shaped meander of river Jhelum seen from the top of Shankaracharya Hill in Srinagar. Poplars, chinars and clusters of houses are seen in the foreground.

Fig 6. Panorama from Bandipur Karewa showing Wular Lake and part of newly formed land along its northern edge, produced by silting. Though it is often flooded, trees have taken root in the new soil.

Fig 7. A typical Kashmiri village in the valley on the bank of river Jhelum. The houses have two or three storeys. Shikara boats, seen in the foreground are used for transport.

Fig 8. A Dungha boat in river Jhelum. This boat has been hired by tourists. A large number of such boats are however used as living houses by Kashmiri families.

Fig 9. Mira Kadal (bridge) in Srinagar. A number of large goods-carrying boats and a Dungha boat are seen in the foreground. Note the predominence of wood in the building of the bridge, boats and houses. Wood shingle is used for making roofs.

Fig 10. The lake in Nasim Bagh area of Srinagar. Floating garden blocks, which produce vegetables are seen on the edge of the lake. A shikara is going towards them.

Fig 11. A typical house of the valley. It is has three storeys. Stone and wood are mainly used for building them. This house is in Kundbal village on the bank of Manasbal lake.

Fig 12. The large spring at Anantnag. The water comes out from the rocks behind the temple, which is constructed over the spring. A town has grown around the spring and the temple.

October. The delicate orange coloured stigmas of the flower, carefully plucked and dried, constitute the article which is widely used for colouring and flavouring confectionery and Kashmiri dishes. Saffron can however, be easily adulterated by mixing it with artificially coloured grass. The soil of this Karewa is said to be specially suited to the cultivation of saffron[5]. In any case saffron is rarely cultivated in any other part of the valley, though it is so remunerative. The saffron lands are however being encroached by the expanding urban development along the road from Srinagar only 12 kilometres away. A good amount of land has been acquired for the new radio station. Maize, barley, vegetables etc. are also grown at suitable places. Almond gardens are found on dry upper portions.

## The Valley Bottom

Jhelum and its tributaries have gradually removed the Karewas completely from nearly half of the vale of Kashmir. The rivers flowing in this portion have their base level of erosion in the Wular Lake. Also they are overburdened by huge amounts of of silt, pebbles, sand etc. brought from the high mountains where they run as torrents through steep gorges, where frost action is very much pronounced. They also bring down eroded material from the Karewa beds. Their beds in the valley bottom are therefore filled up with sediment. The rivers are shallow and run in braided courses. They meander leisurely on a flat terrain and easily flood the low valley surface after a storm. (Fig 5)

It is further quite probable that the outlet at Baramula is not sufficiently deep to allow incoming water to drain out quickly The result is the creation of Wular and many other lakes as well as large marshy tracts which are inundated periodically. Nearly half of the lower portion of the valley bottom in the north west is marshy. However the double process of the erosion of the obstruction at Baramula and silting of the lakes may gradually reduce their size. A large tract of new land is emerging in this manner near Bandipur (Fig 6). Kashmiris living in this "low land" have adapted their life to this watery environment. A ccnsiderable number of them actually live on water in a variety of boats. The river and canals provide a very important means of transport. Leaving out the luxurious house boats, which are miniature floating palaces for entertaining tourists, there are a

great variety of boats. The most mobile among them is the "*Shikara*", not the jaunty multicoloured, cushioned thing which tourists and visitors use in Srinagar, but the bare, sleek canoe which is used all over the valley bottom as a personal transport by the Kashmiri village folk. The "*Dungha*" boat is a utility crafts of medium size, and very often forms a complete house with two or three small bedrooms and a kitchen for a family. Big sturdy load carrying boats carry sand, bricks, stones etc up and down the Jhelum. They also tow logs of wood to Srinagar. In Srinagar shikaras form floating shops, selling vegetables, fruit and a variety of other goods. Timber from the surrounding forests on mountains provide material to built not only the boats, but bridges and dwellings. The roofs are made of wood shingle made from soft pine wood. (Figs 7, 8, 9 and 11)

The river and the lakes abound in fish. The Government has also opened a number pisciculture centres, such as those at Harwan and Achhibal, from where trout and other types of valuable fishes are being distributed in various rivers of the valley. Spearing of fish in the crystal clear water of Manasbal lake by scores of villagers every morning is intresting to watch. Fishermen live in temporary huts and boats in the marshes surrounding Wular lake. They catch fish in large quantities and dry them.

Water chestnuts grow in Wular lake and are picked by Kashmiris and eaten fresh or baked. The water also yields lotus stalks, which are very much relished. Round about Srinagar there are many "floating gardens" made up of earth mixed with twigs, roots etc. They grow excellent vegetables. Edible mushrooms of many varieties called "Guchhi" are an important item of Kashmiri diet (Fig 10).

A feature of the present landscape is planting of rows of willow and mulberry trees along the roads, besides the graceful poplars, which have lined Kashmir roads in the past as well as present. Willow sticks for wicker work and mulberry leaves for sericulture add to the utility of road side trees. Plantations of these two trees in suitable environmetns are also increasing. Another tree of great utility is the walnut. Beside yielding an excellent nutricious nut, much in demand througout India, it provides fine-grained wood which is carved into exquisite designs by Kashmiri craftsmen. The stately "Chinar" is a common shade tree in

gardens and roads. Its star like leaves appear in Kasmiri art goods, in embroidery, wood carving and silver ware, and it may well be called the national tree of Kashmir. The girth of the trunk of a Chinar tree often exceeds 10 metres and is occasionally as large as 20 metres.

The rythm of life in the valley is, however, very much controlled by the seasons. The advent of spring means the melting of snows in the valley and sprouting of leaves and blooming of flowers in a riot of colours. Paddy is sown in the well terraced fields and lowlands. On high banks of soil maize fiourishes. In the fruit orchards apples and pear trees are clothed with white and pink flowers.

There is a great influx of tourists in the valley, and Kashmiris are busy earning money by catering to their needs in a variety of ways. Kashmiri art goods—embroidery, shawls, silks, furs, papier mache goods, walnut furniture, carved art goods, wicker work, jewellery made from imported and local stones, silverware, etc are sold by clever salemen to them. Houseboats and hotels have a roaring business. Guides, porters, ponies and mules are provided to trekkers.

As the season advances vegetables and fruits appear in the market in abundance. They are dried for use in winter.

As winter approaches in October and November the tourists leave the valley and Kashmiris get busy in domestic affairs. They spend the money earned in festivals and marriages. But soon the craftsmen get busy in preparing art goods. There is no agricultural activity, and the famed cottage industry of Kashmir flourishes indoors. The art goods produced are stocked for sale in the coming year. These industries include spinning and weaving of wool and silk, walnut carving, stitching, needle work, embroidery. silver wares, papier mache, fur and wicker products.

The usual dress of Kashmiris in winter is a loose cloak of wool. The body, however, is kept warm by a charcoal fire in a small earthen pot fitted in a wicker case and kept in touch with the bare skin near the bosom. This contraption in called "Kangri". It leaves a black burnt mark on the skin, The Kashmiri heaves a sigh of relief as spring comes once again and snow starts melting.

A striking geographical feature of the valley is the large number of springs found skirting the valley fringe. A spring line can almost be drawn by joining them up, The springs generally

ooz out from below Triassic limestones and dolomites "A thick series of compact blue limestones, slates and dolomites is conspicuously displayed in many of the hills bordering the valley to the north. They compose a very picturesque feature of the landscape, noticeable by the light coloration of their outcrops and their graceful long and undulating folds, which bring them out in strong relief against the dark coloured cragy lavas and slates of the underlying Panjals. Numerous springs of fresh water issue from the cliffs and prominences of these limestones and form the sources of the Jhelum. The best known of these are the river-like springs of Vernag and Achhibal and the multitudinous springs of Anantnag and Bhawan" (Matan)[3] (Fig 12).

The springs were made, good use of by Moghul Emperors, specially Jehangir. Gardens and fountains were built below them. The gardens below Chashma Shahi or the "Royal spring" near Srinagar, Achhibal and Vernag are famous for their beauty.

The springs also became centres of religion, as at Anantang and Matan. The towns here grew around the springs and the associated temples.

The size of these springs is noteworthy. They must be outlets of underground tunnels of water burrowed in the limestones. The water is supplied by melting snows on the ranges above.

The caves of Matan and Aish Maqam are also examples of limestone topography. The cave at Matan is a dried up tunnel a few hundred metres long. It breaks into a number of branches just like the tributaries of an underground river.

In areas where moraines cover the limestones, the springs come out from many points in the morains.

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# CARTOGRAPHIC LIMITATIONS OF MAPS

By **Sivaprasad Das Gupta**

When we look at a map we do not usually feel that it might be misrepresenting or even hiding many geographical facts. We are apt to take the exactness and truthfulness of maps for granted, for after all seeing is believing. But in reality a map does not tell all that it pretends to tell. All maps, however well done, have certain limitations of their own though it may not be readily apparent on the face of it ; under certain conditions maps can even lie. Imperfections of varying nature commonly occur on a map on account of its projection, scale, cartographical technique, reproduction method etc. Some of the inherent defects of maps, though modifiable to a degree, are in fact bound to occur on account of the mapping process itself and are therefore unavoidable. But map users as a rule are hardly aware of the hidden limitations of maps. Map readers obviously take various map symbols, such as a contour, an isopleth, a population dot, a boundary of vegetal kingdom, as something of definite location, proportion and magnitude. We usually forget that many items firmly shown on maps, such as parallels, meridians, contours, isopleths, boundaries etc., are something imaginary, merely symbolical, unreal and sometimes even deceptive. It is, therefore, worth while to examine the nature of cartographic limitations of maps and to have a glimpse into the map makers' world of deception, so that we might be well aware of the inner weaknesses as well as of the basic qualities of maps.

**Type of maps—Survey maps :**

Different types of maps, varying in scope, purpose, content and cartographical execution, have peculiar limitations and characteristic features of their own. A wall map, for instance, fundamentally differs from a sheet map or an atlas map with regard to the degree of accuracy, amount of details and form of presentation. We may classify maps into two basically different groups: survey maps and geographical maps, each being characterized by special problems peculiar to it. Survey maps of various types such as topographical,

geomorphological, geological, pedological and landuse maps are prepared on the basis of actual field observations and surveys. Of these, the topographical maps form a class by itself while the rest may be grouped as survey maps of special types. The scales of all survey maps are usually large enough, 1:250,000 or larger, so that the features shown on a map are identifiable on the ground. Different methods and degrees of accuracy may be adopted in topographical and specialized surveys. The final result, in the form of map, therefore depends much upon the method and intensity of the original survey. Maps prepared on the basis of a relatively closer net-work of field traverses are obviously of much higher order of accuracy than those which are based on scantier observations in the field. Reliability of a map may vary from its one part to another depending upon the varying method, intensity and periods of field observation. On many a topographical map an index of reliability is given so that a map reader may be in the know of the authenticity of different parts of the map. But on specialized survey maps no such indication is generally given. In the case of soil and landuse maps, for instance, no standard classification has so far been evolved. The look of such a map varies according to the method of classification adopted in the survey. Such maps, therefore, are not strictly comparable to each other unless the mapped areas are surveyed by one and the same organization. Certain specialized maps, particularly soil maps the details of which cannot be readily checked in the field or the boundaries of which are not sharp enough to be identifiable on the ground itself, are likely to be unreliable and are to be treated with an element of caution.

**Geographical maps—Simple and Complex :**

Geographical maps, on the contrary, are usually on small scale, 1:1 million or smaller, mainly depicting spatial distribution of various physical, economic, social or cultural features. These maps are of entirely different style and purpose and are usually meant for analytical studies rather than for field use. Being on small scale, geographical maps can only show certain selected features, emphasizing the aspects peculiar to the map and eliminating the less important and unnecessary details. Geographical maps are necessarily more generalized, more limited in scope and

less accurate in locational and physical details. It is the geographical maps which particularly suffer from various cartographical problems and limitations in a varying degree depending upon the different styles, forms, purposes and techniques of mapping. Geographical maps can be broadly subdivided into two major types : simple and complex, the former showing only absolute facts in a straightforward manner without attempting to indicate inter-relationships, while the latter depicting an integrated picture of several inter-connected features together in a complex whole. In this sense a map showing pure distributions, such as population by dot symbols, is a simple map, while another showing the inter-relation and correlation of more than one distribution, such as density of population per unit area of arable land, is a complex map. One is analytical and the other is synthetical in approach. Simple maps represent basic geographical facts in their true magnitude and location. It is, therefore, relatively easy to visualize the picture represented on a simple map. But it awaits further interpretation for revealing the inter-relation of facts. If a simple map attempts to picture the primary facts, a complex map envisages to give a synoptic view of a set of facts. A complex map depicts a more comprehensive picture as it encompasses a number of phenomena as related to each other. Usually many complex maps tend to be over-loaded with information. As a result, these maps are sometimes overdone and are often difficult to read, analyse and interpret. Several techniques of complex mapping have been recently developed in U.S.S.R., Germany and other parts of Europe and complex atlases, such as the German Planning Atlases, have recently come out. Techniques of complex mapping have also been applied to many maps of the National Atlas of India. But it does not follow that simple maps are necessarily easy to read and are less useful maps compared to the complex ones. On the contrary, a simple map may also be full of very useful information, even sometimes be overloaded with facts while a complex map may be empty-looking, over-generalized and sometimes depicting false relationships between divergent aspects.

**Cartographic Techniques :**

The shape of both simple and complex maps depends upon the cartographic techniques employed. Mapping techniques may

be classified into three broad types : chorochromatic, cartogramatic and choroschematic. Chorochromatic maps show only areal coverage of different features by use of distinctive colours or shades applied in patches over appropriate areas of a map. Geological, landuse and soil maps are typically chorochromatic in nature and are usually derived by reduction and generalization from the corresponding large scale survey maps. Cartogramatic maps, on the contrary, usually indicate various distributions by quantitative symbols and cartograms. By far, in majority of geographical maps cartogramatic principles are employed for showing physical, social and economic aspects. Choroschematic maps indicate features of rather indefinite and generalized areal extension by tints, written descriptions on the map itself or by qualitative symbols covering the required parts of the map. Ethnological, linguistic, botanical or zoological distributions are usually shown by choroschematic methods. In geographical mapping, particularly in complex ones, all these techniques are used either singly or in combination.

Mapping techniques and reproduction methods vary according to the ultimate use and the style of the map. We may have several varieties, such as a wall map, sheet map, atlas map, sketch map and specialized map. Wall maps, for example, are necessarily crude and highly simplified as they are meant for viewing from a considerable distance, and as such, the lines on these maps are drawn rather heavily. Obviously such maps are neither accurate nor exhaustive. In preparing wall maps emphasis is laid on the visual effect rather than on minute details. In sheet mapping, on the contrary, it is possible to show greater amount of details. But with sheet maps it is difficult to depict an over-all picture of a country since several sheets are usually required to cover a single country. In some cases different sheets of one and the same series may come out in different times and as a result, the earlier sheets of a series may be quite out of date when the last ones are published. Survey maps, both topographical and specialized, are necessarily sheet maps. Atlas maps are fundamentally different from sheet maps and are typically geographical in nature. The size of atlases is usually restricted to certain limits because they are meant for keeping on library shelves and for handy use and this necessitates the use of smaller scales for the maps, or the maps

have to be divided into sections to fit into the size of the atlas. Since atlas maps are read from a closer distance, the letterings and lines on the map can be made finer and smaller. As a result, atlas maps are capable of accommodating much greater amount of details than what other types of geographical maps can do. Maps, usually atlas maps, are printed in many colours and are expensive. A great deal of technical refinement is possible in these maps. Atlas maps may be regarded as the best media of cartographical representation. Maps of single-country atlases, national atlases as they are more popularly known, form a special class by themselves. Sketch maps illustrating scientific papers, theses, books, newspapers and other publications are much simpler in design compared to atlas maps and are usually printed in one colour. Since such maps show specified and selected features, these are more limited in scope and simple in composition. Obviously sketch maps are not meant to show intricate details and cannot be complete by themselves ; they must be read with reference to the text accompanying them without which they are often valueless. News maps, which appear in periodicals illustrating the places of of important events, form a special class of sketch maps. These maps depend more upon their news value. Generally they are compiled and drawn hurriedly with the barest minimum of details focussing attention upon the high-lights of news items which they illustrate. Besides sketch maps, there is a large variety of special-purpose maps, such as weather map, aeronautical and navigational charts, planning maps etc., which are usually meant to be handled by persons connected with the trades concerned. Obviously these maps contain information of more specialized nature. In preparing these maps special methods and symbols are used the interpretation of which requires special knowledge of the particular branch of science. Though usually simple in lay-out and printed in few colours containing only the barest minimum information required to fulfil the limited purpose, these maps may look quite complicated to ordinary readers. It is not surprising that, being specialized in nature, these maps are often very poorly drawn and badly printed.

**Problem of Projection :**

Besides these technical limitations of maps, pertaining to their different styles and types, there are number of problems of

mapping commonly affecting all types of maps in general. One such problem is derived from the peculiar properties of map projection itself. No map is a true replica of the earth. Projection is a special mathematical device for representing the curved spherical surface of the earth on a plane surface. A curved surface can never be represented or projected on a plane surface without resulting in some distortion or other in shape, area, distance or bearing. All maps depict distorted views of the earth though the nature and amount of distortion vary from projection to projection. Strangely, this obvious fact is not usually appreciated by common readers. In order to meet various requirements of maps, a number of projections have been devised, each having certain qualities of their own. Certain projections may show some particular aspects more accurately at the expense of the others. It is the content of a map which determines what projection will suit best for the purpose. A carelessly chosen projection may result in gross cartographical inaccuracy and may convey wrong impression to map readers. For instance, in the well known Mercator projection the scale increases so rapidly towards the poles that the countries in higher latitudes look much bigger than what they actually are. Obviously if we want to measure distances or areas on the Mercator projection we shall be getting very strange results. Unfortunately, for some reason or other, this projection gained great popularity in Europe during the last century. As a result, erroneous ideas about size and shape of countries were created amongst men. Such ideas are still being handed down to this day. In many atlases this projection is frequently used even now just because we are more familiar with it.

The projection-error affects the accuracy of both distance and direction which are the very fundamentals of a map. Errors in size or shape or in both occur on a map due to the peculiarity of its projection. The graticule of a projection is the basic framework on which a map is built up. But this framework itself is invariably distorted and is bound down by various limitations. All projections have certain properties of their own, peculiar to different types. The names of systems of projections indicate their qualities. But one should not be misled by the names of projections. Certain projections are veritable misnomers.

The so-called equidistant projection, for instance, does not show distances correctly all over the map, as the name might suggest. On such projection, distances from only one particular point or along certain direction may be correctly shown as the case may be. We often try to measure distances on a map with the help of the scale indicated on it, but no projection has so far been devised which can show the correct distances between any two points on the map. Similarly, orthomorphic ( right-shape ) projections do not at all show shapes accurately as the name implies. Orthomorphism is merely a mathematical condition indicating that in such projections the meridians and parallels intersect each other at right angles and that at any point on the map the scale along the meridian is the same as that along the parallel ; and that is all. Under these conditions shapes of infinitesimally small areas are theoretically correct but it is not so with large areas, which suffer gross distortion in shape. Mercator is an orthomorphic projection which is notorious for distortion of shapes of countries and continents. Similarly, azimuthal projections do not show the correct azimuths from any point, except only from the point of origin of the map.

The question of projection-error is particularly important in the case of maps of small and medium scales i. e. geographical maps in general. Larger the area represented on a map, more is the projection-error. Projection also plays a vital role in special-purpose maps, such as those of air and sea navigation, in military maps and in cartogramatic maps. It is therefore absolutely necessary to make careful selection of projection and related matters such as the standard parallels, central meridian or the angle of obliquity for each map depending upon the contents and extent of the map. In many ordinary maps this question is overlooked resulting in errors, sometimes with disastrous effects.

Polar flatenning of the earth, on account of its spheroidal shape, also tells upon map projection. As a result, in preparing maps of countries of large latitudinal extension this aspect has to be taken into account. Unfortunately a map usually does not indicate whether its projection is based on a particular spheroid of reference.

**Scale Factor :**

Scale is probably the most important factor in mapping. The question of scale is of particular importance in all geographical maps since these maps are drawn on smaller scales. A cartographer chooses his scale according to the contents of a map. The scale is often determined by the size and shape of paper available in relation to the total area mapped. Sometimes other questions, such as cost of reproduction and printing, have to be considered in selecting the size of a map and consequently its scale. Economy of map-size and scale is always an important consideration in mapping. The scale is the indicator of the total capacity of a map. A map cannot show more details than what the scale allows. The amount of detail, degree of generalization and total capacity of a map vary as the scale according to the law of squares. If the scale of a particular map is reduced to half, the amount of detail must necessarily be cut down to one-fourth for maintaining the same density of details as in the original one. The scale limits the number of the symbols or names that can be shown on a map ; it also indicates the limit of plottability of certain features existing on ground. A chorochromatic symbol covering an area of one $mm^2$ is the smallest that can be shown on a map with sufficient legibility. This indicates the physical limit of plottability of chorochromatic information on a map. On 1M scale a symbol of this minimum size represents one $km^2$ of ground while on 10M scale the same stands for 100 $km^2$. Therefore, any area covering less than one $km^2$ on 1M and 100 $km^2$ on 10M cannot be shown true to scale since they are physically unplottable. Reduction of a map to smaller scales therefore enforces generalization and drastic elimination of details, lowering the degree of accuracy.

In cartographical representation of information on a map there is a limit to the degree of accuracy physically attainable. For instance, on a map lines can be drawn with sufficient accuracy upto the 2nd place of decimal of a centimetre and angles upto quarter of a degree. This physical limitation affects geographical maps particularly, because of smallness of scale ; smaller the scale greater is the percentage of error involved on account of the physical limitation of drawing.

**Cartographic Generalization :**

All maps have to be approximate to some extent or other. Systematic and successful generalization is, therefore, a fundamental keynote in map making. Proper generalization improves a map because it gives clarity and helps interpretation. The smallness of the scale of geographical maps necessitates representation of data in a simplified form with appropriate generalization of details. The degree of generalization required for showing a particular data legibly on a map depends upon the scale and type of data. Generalization in mapping can be achieved in several ways, but much depends upon the method and the degree of generalization. Generalization may be effected by carefully weeding out unnecessary and unplottable details, by grouping similar data or by using selected data in a simplified form. Generalization derived from detailed basic data yields much better result than that based on scantier data. For instance, an isopleth line generalized to a smaller scale from large scale component maps is more accurate than the one which is drawn on the basis cf selected and fewer control points directly on the small scale map itself. Accurate and reliable generalization requires more detailed knowledge of facts. This is particularly true of chorochromatic maps which require detailed surveys in the field before generalization can be attempted. Generalization is an art by itself. A map may undergo radical transformation by slight changes in the method and the degree of generalization. The mere look of a map, which might even be deceptive in certain cases, does not reveal its real worth unless the degree and method of generalization employed in it are known. Unfortunately, maps ordinarily tend to become over-generalized because it is difficult to stick to arduous rules of systematic generalization and also because of the fact that it is quite easy to cover up the defects of over-generalization under the colourful appearance of a map. Usually a map does not tell, on the face of it, what amount of generalization has been carried out in it.

**Method of Representation :**

The look of a map depends much upon the cartographical method adopted in presenting the data. There might be several alternative methods to represent the same data. Each method of

represention has its merits as well as demerits. Different techniques may bring out entirely different pictures from the same basic data ; sometimes even the one and same method may result in widely different presentations just by slight alteration of criteria and standards. A cartographer may change the face of a map by simple trickeries.

The scope of various quantitative methods, used particularly in cartogramatic maps, is more or less restricted ; certain aspects revealed by one method may be kept hidden by another. Both choropleth and isopleth methods, for instance, may be used to indicate ratios and percentages, like density of population. But the patterns revealed by choropleths are entirely different from those revealed by isopleths. Both of the methods have their difficulties and advantages. But to scrupulous cartographers both of these methods are equally unsatisfactory because neither can bring out the true picture. Both choropleth and isopleth maps tend towards over-generalization. Moreover, the degree of generalization in such maps, particularly in a density of population map, cannot be maintained at a uniform level throughout the mapped area, for the degree of generalization varies with the variable sizes of the administrative divisions the data of which have been used for preparing the map. Again, the apparent uniformity of distribution, as depicted on a choropleth map, is contrary to actual fact. The gradual variation of distribution as indicated by a series of isopleth lines, is too arbitrary, as in the case of population distribution. Appropriate choice of group intervals is another problem in both choropleth and isopleth mapping. The face of a map may be transformed greatly by slight changes in group values. A particular map, therefore, is just one of the many alternative possibilities, and no map is the last word for it. Isopleths are usually drawn by method of interpolation from the observed or computed values of data at different control points of a map. The isopleth pattern largely depends on the density of these control points. A rainfall map, for instance, based on data for a very large number of stations materially differs from the one prepared on the basis of data of a relatively fewer stations. In practice, isopleth mapping is not so straightforward an affair as it seems, because from the same data many alternative, anomalous and doubtful alignments of

isopleth lines are obtained which always intrigue cartographers. The apparently bold and firm isopleth lines on a map may often be hiding behind them many hesitations and manoeuvres of the cartographer.

For representing the relief of land several methods have been devised of which hachures and contours are the most important. But none of the methods is really very satisfactory. The hachure system is capable of depicting hill features extremely well and the three-dimensional aspect of relief can be very vividly represented. But the method is not successful in depicting non-mountainous and flattish areas. Hachures of really good standard are particularly difficult to draw and cannot be well reproduced by the currently used methods of printing. These are better reproduced by copper engraving which is a laborious, expensive and now practically a discarded process. Contours have, therefore, largely replaced hachures on modern maps. But a contour map cannot reveal all aspects of relief either. Here again is the problem of contour intervals as in this case of all isopleths. By contour method, relief features of the belts lying between two consecutive contours cannot be shown at all if the relative heights of these features are less than the contour interval. Thus sometimes many important hill features may be found altogether missing on a contour map because of a particular contour interval. Contours cannot show breaks of topography unless the breaks accidentally coincide with the chosen contours. Even on one-inch topographical maps with the usual contour interval of 50 ft it is impossible to distinguish features having relative heights of less than 50 ft. The contour interval problem is more intriguing in the case of small scale geographical maps where the contours have necessarily to be spaced at larger intervals. A small-scale contour map is necessarily highly generalized and diagramatic in nature.

The devices which are available at the disposal of cartographers for symbolization, both quantitative and qualitative, on maps are surprisingly few in number ; dots, circles, spheres, cubes, squares, lines, bars, bands and pictograms are the few common variants used as symbols. Mere presence of symbols on a map does not necessarily mean their locational accuracy. Often on common cartogramatic maps symbols are very roughly located

because the symbols are of too large a size compared to the scale of the base map. The dot symbol is one of the most versatile tools popular with all cartographers. A dot can indicate location, quality and quantity. Quality can be indicated by colour and shape of dots and quantity by size and number of dots; it can also represent distribution of dispersed character very well. But maintenance of locational accuracy of dots is not at all an easy affair, unless detailed information is available. Plotting of dots is an extremely difficult problem in cartography. Ordinary dot maps, therefore, are usually over-generalized and somewhat arbitrary. Many dot maps are very much subjective because cartographers use their discretion in making local variation of concentration of dots in each administrative division. When dots are plotted over an administrative area of a map, the total quantity represented for the area is roughly correct. But sometimes, particularly on large scale maps, dots are placed on more exact spots in small groups; in such cases there occurs certain quantitative error in each operation of plotting of dots depending upon the dot-value; suppose, a dot stands for $n$ units, then obviously, it can show only multiples of $n$s. If the common principle of approximation is applied, one such dot may stand for any value lying between $n-n/2$ and $n+n/2$ units. Therefore, in this case there is a probability of a quantitative error of $\pm n/2$ for each operation of dot plotting; this may be termed as operational error. Within larger areas, however, the roughly equal amounts of negative and positive errors for each individual operation are expected to cancel themselves. But the fact is that an error exists for each individual group of dots and usually a sizeable residue of error accumulates within an administrative area, either on positive or negative side.

**Availability of data:**

Geographical maps depict various physical, social and economic data. Accuracy and exhaustiveness of basic data are primary requisites of a good map. But in actual practice we find that reliable and complete data are hardly available. Even census figures, which are commonly regarded as reliable, reveal many gaps and inaccuracies. It is difficult to get detailed data particularly for large countries like India, because adequate machinery for collecting

data does not exist. That is why all data, which involve collection of information specially at local and village levels, are not very reliable. In this country the smallest administrative division, for which published data are readily available is district. Districts are rather too large in area for any detailed mapping. Break-ups of figures for smaller units like thana or tahsil are generally not available. As a matter of fact, for drawing large-scale maps detailed information on village to village basis is required. For compilation of certain chorochromatic maps, such as geological, landuse and soil maps, it is essential to have the information in the form of large scale field maps and survey reports. But unfortunately, very little field information and field mapping has been so far done in this country except in the case of geology. In practice, maps are prepared based on whatever data are readily available. Cartographers, therefore, have to devise methods of inference, interpolation, extrapolation, etc., to fill up gaps and to even out anomalies and inaccuracies of data. A complete map, therefore, does not necessarily mean cent per cent coverage and accuracy of the source material. As a matter of fact many maps are drawn on the basis of surprisingly meagre data.

**Map Reproduction :**

Map reproduction is the last stage in cartographic process. Success of a map depends on how it is printed. Reproduction methods inflict several practical limitations in cartography. All that can be drawn on a manuscript map is not necessarily reproduceable. Maps meant for publication are prepared and drawn, with an eye to the possibilities and limitations of the final printing method. Maps can be printed by letter-press and offset methods in one or many colours. The letter-press method is cheaper but hardly satisfactory and is suitable for maps of one colour only, whereas the offset process is equally good for both single-colour and multicolour maps. The scope of uncoloured maps is very limited. Colour is an important factor determining the range of mapping possibilities, but multicolour printing is very expensive. That is why it is necessary to use only minimum number of colours in map printing. Sometimes colour economy necessitates severe reduction of details of a map.

Before the discovery of lithographic processes, maps were

usually reproduced from engraved plates. Engraved maps are of superb quality but it is a very costly process because the rate of printing is extremely slow. With the development of lithographic process and consequent improvement of offset printing it is now possible to produce cheaper maps on mass scale though the final product is not as good as the engraved ones.

Whatever process of printing is adopted, some cartographic symbols do not come out well on the final print. For instance, we find that hill shading on maps reproduced by half tone process never prints well, however well-drawn the originals might be. This is due to the fact that the photographic emulsions used on negatives are not technically capable of taking perfect impression of both the lightest and darkest tones of hill shading at the same exposure. Hence the tonal variation, which is the very essential feature of a shading, is not fully reproduced on a print.

Printing ink and paper are also important factors in map reproduction. Sharpness of lines and tone, contrast and brightness of colour tints depend upon the quality of ink and paper. Printing inks generally spread, more or less, on paper through its fibre system. Unequal spread of different inks on different papers affects the general legibility and alters the size of quantitative symbols on maps. In certain cases this problem may assume a serious proportion. For instance, on a map showing urban population by circles in different colours, a circle printed in red will be a trifle larger than the same printed in black due to the greater tendency of red to spread out radially. Poorer the quality of ink and paper more unsharp and illegible are the lines and symbols on a map. Technical limitations in the final printing processes always have to be taken into account in preparing maps. It is difficult, for example, to print more than 9 graded screens in one colour and 15 layer tints in multicolour on a map. This practical difficulty affects all geographical maps in general and and choropleth and isopleth maps in particular. Therefore even when a great range of detailed data is available it cannot be sometimes fully utilized because it is not possible to reproduce more group values than what the printing process allows. Similarly, the number of distinctive colours and shades that are printable is very much limited. Chorochromatic maps which require many colours are, therefore, particularly affected on this account.

Take for example the case of a geological map of a large country ike India on which it is desirable to have as many as hundred distinctive shades to show all geological formations and series, but it is impossible to print as many as that. It is, therefore, necessary to group the formations to a printable number, some 30 or so, and sacrifice many details. In practical map making it is, therefore, essential to strike a compromise between the amount of mappable data available and the limited capacity of the printing process involved.

**Conclusions :**

Map making is a creative art ; maps are, as all other artistic creations, highly subjective. The subjective element in mapping always plays a very prominent role. As a result, maps are very much liable to personal error at every stage of the process of preparation. Systematic check-up, at different levels of map making, starting from the initial stage of compilation to the final print, is a fundamenal prerequisite of successful cartography. There is a very wide range of choice that a cartographer can make for the different elements of a map under preparation. There are a number of projections to choose from ; one has to decide the scale and general layout which form the initial structure of a map. Much depends upon the method of processing, selection, modification and generalization of the source materials which are the very substance of a map. The make-up of a map rests on the method of representation and symbolization and on the selection of standards, criteria and colour scheme. The final look of a map largely depends on the artistic ability of the printer also. Preparation of a map demands imagination, judgement, patience and industry on the part of the makers of the map. It is the cartographer who can either make or mar a map.

No map is a final say ; it is one of the several alternatives possible. We should not take a map complete by itself ; many things remain untold and cannot be adequately expressed on a map. To make full use of a map and profit from it, one must be aware of its possible limitations and should appreciate its problems of projection, scale, symbolization, method, availability of data and printing difficulty.

# PEDOGENESIS IN RAJMAHAL-II.

## STUDY OF A SOIL CATENA AT SAHIBGUNJ

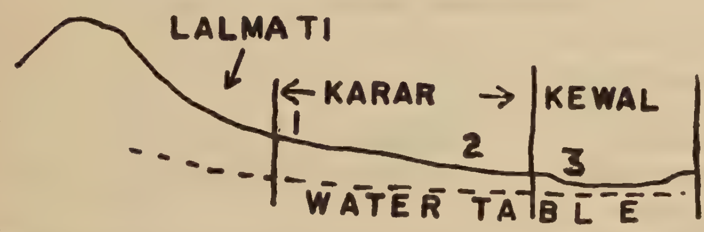
**S. P. Chatterjee, R. Lahiri, R. Bhattacharyya.**

Genetically, soil forming processes act both directly and, through vegetation and other biotic factors, indirectly on a given parent material, itself the result of the action of weathering processes on a parent rock. The operation of the weathering and of the soil forming processes takes place in time, which thus affects, although not causally, the final result[1]. The influence of topography in soil formation is not as unimportant as it appears from the above statement. Workers in temperate climates have shown that the relief of the land has a considerable influence on the genetic character of the soil. In fact some pedologists have worked out "Soil Association" on the basis of the variations in the relief and the position of the water table. The influence of landforms on the soil types was especially studied by late G. Milne while investigating the soils of Tanganyika, and proposed the name 'Catena'[2], to express a sequence of soil profiles which appear in a regular repetition in association with a region possessing a regular succession of certain topographical features[3]. The classical example of this is found in Tanganyika where red-earths or red-loams are found in elevated well drained sites with *vlei* or *mbuga* soil in depressed sites, side by side. This indicates the topographical and hydrological conditions which influence the profile and consequent soil formation of a particular locality, where the underlying rock is unifrom. The catena concept not only directs attention to the relationship of different soils developed on the same parent material but is also a convenient unit for mapping such complex areas. This concept was further amplified by T. M. Bushnell[4] who worked out a complete soil classification on this basis. According to him,

> "Simple catenas are made up of series homologous in all features except those due to drainage variations.
>
> "Multiple catenas are groupings of catenas, homologous in all features except those due to some one formation factor in respect of which there is a gradation of characteristics"

In the study of pedogenesis and soil taxonomy this is undoubtedly a new approach but it is difficult to ascribe any special merit to this system at this stage[5].

That this concept of soil catena can be used with profit to explain the nature and the distribution pattern of the different soils of Rajmahal is illustrated by describing three soil types ( *Lalmati*, *Karar* and *Kewal* ) of Sahibgunj. The following sectional diagram shows the occurence of these three soil types which have catena relationship between one another.




NUMBERS INDICATE PROFILE SITES.

DIAGRAM

DESCRIPTION OF SOIL PROFILES :

Profile No. 1

| | |
|---|---|
| Locality | Sahibgunj. Kelabari. |
| Marco relief | Hill slope. |
| Elevation | |
| Site and slope | Gully face, slopes from south-west to north. |
| (Topographic situation and slope) | Gully face, left side. |
| Aspect | South-west. |
| Parent material | Basalt. |
| Vegetation | Short grass. |
| Profile drainage | Free drainage' |

| | |
|---|---|
| 0—30·5cm | Yellowish brown gravelly soil, crumb structure, loose with few fine roots, dry, changes gradually to |
| 30·5—61cm | Light gray with no roots and stones, loose in a highly weathered state showing vertical and horizontal joint like structure, dry, changes gradually to |
| 61—81·3cm | Light gray with no roots and stones, loose in a highly weathered state showing vertical and horizontal joint like structure, dry, gradually changing to |
| 81·3—127cm | Light yellowish brown colour with no roots stones, loose in a highly weathered state showing the features noted above. |

Profile No. 2

| | |
|---|---|
| Locality | Sahibgunj. |
| Macro relief | Lower slope of the hill. |
| Elevation | |
| Site and slope | Gully face. Slopes from south to north, |
| (Topographic situation and slope) | Gully face, left side. |
| Aspect | West. |
| Vegetation | Grass. |
| Profile drainage | Good. |

| | |
|---|---|
| 0—7·6cm | Yellowish brown, crumb structure, hard, few fine-roots, few small stones, dry, changes to |
| 7·6—15·2cm | Yellowish brown, crumb structure, hard, little roots, many stones, dry, changes to |
| 15·2-30·5cm | Dark yellowish brown, crumb structure, loose, no roots, stones of different size, dry, changes to |
| 30·5-50·8cm | Dark yellowish brown, crumb structure, loose, no roots, stones of quite big size, dry, changes to |
| 50·8—81·3cm | Dark yellowish brown, columnar structure, hard, no roots and stones, slightly moist, changes to |
| 81·3—111·8cm | Very dark brown, columnar structure, soft, no roots and no stones, wet, changes to |
| 111·8—142·2cm | Very dark gray brown, columnar structure soft no roots and no stones. wet. |

Profile No. 3

| | |
|---|---|
| Locality | Sahibgunj. |
| Macro relief | Plain. (Low) |
| Elevation | |
| Site and slope | Stream bank, Slopes from south to north. |
| (Topographic situation and slope) | Stream bank, right side. |
| Aspect | West. |
| Vegetation | Grass. |
| Profile drainage | Good. |

| | |
|---|---|
| 0—7·6cm | Brown, columnar structure and compact, few fine roots, little stones, dry, changes to |
| 7·6—15·2cm | Dark brown, columnar structure, hard and compact, no roots, no stones, dry, changes to |
| 15·2—30·5cm | Dark yellowish brown, columnar structure, hard and compact, no roots, no stones, dry, changes to |
| 30·5—61cm | Dark brown, columnar structure hard in upper parts and soft in lower parts, no roots, no stones, wet in lower part, changes to |
| 61—91·4cm | Very dark brown, columnar structure, soft, no roots and no stones. |

Table—1

Colour Profile :

| Depth in cm | 0 | 7·6 | 15·2 | 30·5 | 50·8 | 61 | 81·3 | 91·4 | 111·8 | 127·0 | 142·2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Profile 1 | 10 YR 5/4 (10 YR 4/2) | | | 2.5 Y7/2 (2.5 Y5/2) | | 2.5 Y7/2 (10YR4/2) | 2.5Y 6/4 (2.5Y 4/4) | | | ←→ | |
| Profile 2 | 10YR5/4 (10YR3/3) | 10YR5/4 (10YR3/3) | 10YR4/4 (10YR3/4) | 10YR4/4 (10YR3/4) | 10YR4/4 (10YR3/3) | | 10YR4/3 (10YR2/2) | | 10YR4/3 (10YR3/2) | | |
| Profile 3 | 10YR5/3 (10YR3/2 | 10YR4/3 (10YR2/2) | 10YR4/4 (10YR2/2) | 10YR4/3 (10YR2/2) | | 10YR4/3 (10YR2/2) | | | | | |

Table—2

Organic Matter Profile & pH Profile :

| Profile 1 | | | Profile 2 | | | Profile 3 | | |
|---|---|---|---|---|---|---|---|---|
| Depth in cm | Organic Matter | pH | Depth in cm | Organic Matter | pH | Depth in cm | Organic Matter | pH |
| 0-30·5 | 2.68% | 8.9 | 0-7·6 | 4.21% | 9.0 | 0-7·6 | 4.90% | 9.4 |
| 30·5-61 | 2.48% | 9.0 | 7·6-15·2 | 3.87% | 8.4 | 7·6-15·2 | 4.56% | 9.3 |
| 61·0-81·3 | 2.37% | 9.0 | 15·2-30·5 | 2.58% | 8.9 | 15·2-30·5 | 4.56% | 9.2 |
| 81·3-127 | 2.37% | 9.1 | 30·5-50·8 | 2.63% | 9.2 | 30·5-61 | 3.87% | 9.3 |
| | | | 50·8-81·3 | 3.74% | 9.1 | 61-91·4 | 2.99% | 9.3 |
| | | | 81·3-111·8 | 4.90% | 9.2 | | | |
| | | | 111·8-142·2 | 4.86% | 9.1 | | | |

Table—3

Mechanical Composition of Soil and Texture Profile :

(Recalculated Sand + Silt + Clay = 100%)

| Depth in cm | Sand | Silt | Clay | Total | Texture after J.A. Prescott & others |
|---|---|---|---|---|---|
| Profile-1 | | | | | |
| 0-30·5 | 64.2 | 18.9 | 16.9 | 100.0 | Loam |
| 30·5-61 | 80.6 | 13.1 | 6.3 | 100.0 | Sand |
| 61·0-81·3 | 58.7 | 21.3 | 20.0 | 100.0 | Loam |
| 81·3-127·0 | 81.7 | 12.3 | 6.0 | 100.0 | Sand |
| Profile-2 | | | | | |
| 0-7·6 | 63.2 | 17.2 | 19.6 | 100.0 | Loam |
| 7·6-15·2 | 62.4 | 14.4 | 23.2 | 100.0 | Loam |
| 15·2-30·5 | 77.5 | 6.4 | 16.1 | 100.0 | Sand |
| 30·5-50·8 | 71.4 | 12.0 | 16.6 | 100.0 | Sandy Loam |
| 50·8-81·3 | 52.9 | 22.3 | 24.8 | 100.0 | Clay Loam |
| 81·3-111·8 | 39.8 | 25.0 | 35.2 | 100.0 | Light Clay |
| 111·8-142·2 | 38.6 | 24.0 | 37.4 | 100.0 | Light Clay |
| Profile-3 | | | | | |
| 0-7·6 | 28.5 | 25.6 | 45.9 | 100-0 | Medium Clay |
| 7·6-15·2 | 29.4 | 25.8 | 44.8 | 100.0 | Medium Clay |
| 15·7-30·5 | 31.7 | 24.8 | 43.5 | 100.0 | Medium Clay |
| 30·5-61 | 32.0 | 26.5 | 41.5 | 100.0 | Light Clay |
| 61-91·4 | 32.2 | 26.6 | 41.2 | 100.0 | Light Clay |

EXPERIMENTAL METHOD :

(a) Soil Colour by Munsell Colour Chart.
(d) Organic matter by Modified Schollenberger method[5].
(c) pH by ADCO Precision pH Meter, in 1:5 Soil-Water dispersion.
(d) Texture by International pipette method.

DISCUSSION :

The three soil types described here belong to one **Catena;** The diagram shows that the *Lalmati* occurs along the higher slope of the hill, whereas, the *Karar* and the *Kewal* occur in the lower slopes of the hill and the medium or low plain lands respectively. In this particular area, since the soils have originated from the Trappean basalt, which predominates in basic elements, the resulting soil, has high pH values (8. 9 to 9. 1), showing thereby that the soil here represents only the weathered parent material. Due to the slope of the land, there is constant loss of the finer materials from the soil by erosion, which again is evident from the light texture of the soil. As the ite is above the water table there can not be much accumulation of organic matter which varies between 2.68% to 2.37% from top to bottom. The top soil is slightly red under field conditions but this colour becomes light yellow at the bottom.

The soils in the low plains, on the other hand have a dark brown colour at the top but in very low lying areas or near to the water table where it is moist, the soil is very dark brown, or black (under field conditions). The basic character of the soil is evident from pH values which vary between 9. 2 to 9. 4. The soil is medium to light clay. It has a high swelling capacity and large fissures are formed in the dry season due to shrinkage. The profile shows well developed columnar structure. The content of organic matter in this soil varies approximately between 3. 0% to 5. 0% which is responsible for the black colouration of the *Kewal* soils.

The *Karar* soil or the soils occupying intermediate position along the slope of the hill, are also alkaline (pH 8. 4 to 9. 2), with compartively lower organic matter content (2. 5% to 4. 9%). Texturally. the top soil is loam, but the subsoil is clay loam to

light clay. This soil also becomes very hard and compact when dry, but becomes very soft on wetting,

From a study of the nature of the clay mineral in these three soils by the method of Differential Thermal analysis[6], it has been found that the predominating clay minerals in these three soil types are :

Lalmati : Kaolin, Illite.
Karar : Kaolin, Illite, traces of Montmorillonite.
Kewal : Kaoline, Illite, & Montmorillonite.

UTILISATON OF THE LAND :

The *Lalmati* on the hill slopes is agriculturally not very important. Because of the slope of the land, and in the absence of terracing or similar soil conservation method being applied, it can not be directly used for cultivation.

The *Kewal* lands are very fertile and form the best arable lands of the locality. All types of cereal crops are grown, depending on the practice of the local farmers.

The *Karar* lands are also good but compared to the *Kewal* lands are less productive, because the top soil has comparatively low water holding capacity. But these soils also easily respond to the application of manure, fertilisers and irregational water.

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# Geographical Notes

## Visit of Russian Geographers

Three Russian geographers, Dr. Leonid E. Rodin, Prof. I. V. Komar and Prof. K. M. Popov, who were in Calcutta in connection with a visit to the country, by invitation from the government, to give advice on regional delineation of India, were invited by the Geographical Society of India, Calcutta to meet some Indian geographers at an informal meeting, which was held in the Director's room of the National Atlas Organisation, Calcutta on 15-5-1961.

There was a fruitful discussion with them regarding methods used by Russian geographers in making planning regions and the use they were put to in development plans. Prof. Komar, who is a specialist on regional economic geography of U.S.S.R., answered a large number of questions put by the Indian gergraphers. He gave a brief history of economic planning since the October Revolution. According to him U.S.S.R. was divided into 16 big economic regions and subdivided further into about 100 integrated regions. They were further subdivided taking 100,000 persons per unit. The big regions were called territorial productive regions. They were specialized regions, the specialization being in conformity with the environment. Each big region also had smaller industries to help the major industries. Smaller political units were often combined to make one big region. But in case of a big political unit, it was subdivided into a number of big regions.

Prof. Popov, who is a specialist on the geography of East Asia and is attached to the Institute of Geography, Academy of Sciences, U.S.S.R., spoke in general of his experiences during his tour in India. He specially emphasized the need for Indian geographers to write more on Indian subjects. He is currently working for the preparation of a general treatise on India.

## National Atlas of India

The first set of population maps on 1M scale, covering a major portion of India will be on sale after a short period. The maps show the rural population by three sizes of dots, the agricultural and the non-agricultural population being differentiated by colours, green and red. Urban population is shown by circles

whose colours and sectors indicate the chief function of urban foci. The maps will prove very useful for business houses interested in markets for their goods, students of geography and demography and the general intelligentzia.

The fasicules for Transport and Tourism maps and Physical maps are also nearing completion. S. C. B.

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The following particulars regarding the ownership of "Geographical Review of India", a quarterly journal, are given below as called for by Rule-8 of The Registration of Newspapers (Central) Rules, 1956.

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# Book Review

VILAGATLASZ—Published by Kartografiai Vallalat. Budapest (Hungary) 1959. Size : 24cm × 34cm. Maps 80 pp. Index 112 pp. Text in Hungarian.

**Vilagatlasz** is an atlas of the world printed and published in Hungary primarily meant for students. Nevertheless it is equally useful for others too. There are a few physical maps of the continents but rest of the maps are politically coloured on which relief is also indicated by means of stump shading. There are a very large number of place names on each plate, yet each name is perfectly legible and clear, indicating high standard of cartography and map reproduction. It is therefore very useful as a reference atlas. Its usefulness has been enhanced on account of inclusion of an exhaustive index of names and beautiful insets showing important towns on larger scales. Several plates are devoted to show Hungary on scale 1:550,000. The whole of Indian subcontinent is shown on one plate (No. 58-59) on scale 1:10,000,000 though parts of India also appear on other plates. It is a pity, however, that the boundaries of India shown here are incorrect. S. P. D.

**Atlas of Economic Development** by Norton Ginsburg. The University of Chicago 1961. pp 119. 24 × 37 cm.

The Atlas with its 48 maps, notes and a statistical analysis aims at locating the developed and underdeveloped countries of the world. The quantitative measurement of the growth of nations which has, in the past been the almost exclusive concern of economists, is being depicted on the world by the new cartographic techniques developed by Mr Ginsburg. All the maps are world maps and the various countries are taken as units to depict a certain distribution by an index, such as wealth, density of population, production, power, transport etc. In all cases the indexes are grouped into six grades shown by tints. A standard type of graph is used to show the distribution curve and its character, the countrywise percentages of the six grades and also the populationwise percentages. The tints are in black and the population density in three grades is overprinted in red.

In some cases novel indexes have been devised to bring out the effective distribution of an object. The most interesting of these is the map No. 26 showing kilometres per person to population distance, a new term introduced by Yuzuru Kato. The statistical

analysis however concludes that the various indexes could be grouped in four types which will be enough to bring out the conclusion.

The atlas is an example of new statistical-cum-cartographical methods coming into vogue in U. S. A. S. C. B.

**The British Isles**—*a Systematic and Regional Geography* by G. Dury. Heinemann, London, 1961. pp. 503.

This is another useful addition to many text books in the subject that already exist. In a country like United Kingdom with rapidly changing economy and advancements in all spheres of activity a review of changed circumstances in their geographical context is essential. The book of Dr. Dury admirably serves this purpose.

The book has been very carefully planned. In the first part the author deals with the physical features, climate, population, trade, industry etc. of the country as a whole. In discussing each of those aspects their evolution to the present stage has been shortly but aptly described followed by a detailed account of the current position.

The second part of the book has been devoted to a detailed description of the broad and well recognised regions into which the country has been divided. The characteristics of each of these regions have been fairly brought out. The treatment of the subject is well balanced ; agricultural economy has not been allowed to be overshadowed by emphasis on industrial economy. The land and the people living on it, have both been provided with their due places of importance in the contents of the text.

The aerial photographs are excellent and are most illustrative. The photograph No. 2, for example, is the best and true picture of what an escarpment looks like. The author has proved his merit as a cartographer by including a large number of informative maps and diagrams in the book. The methods adopted in producing compact diagrams depicting many features on the same map is admirable although in some cases they have become a little complicated. Generalization cannot be avoided in trying to put within the confines of a single text book, the Geography of United Kingdom. Having accecpted that, the book may be easily classed as one of the best of its kind. G. K. D.

# The Geographical Society of India